



Detection of COVID-19 and Cardiovascular Diseases By ECG

Our team



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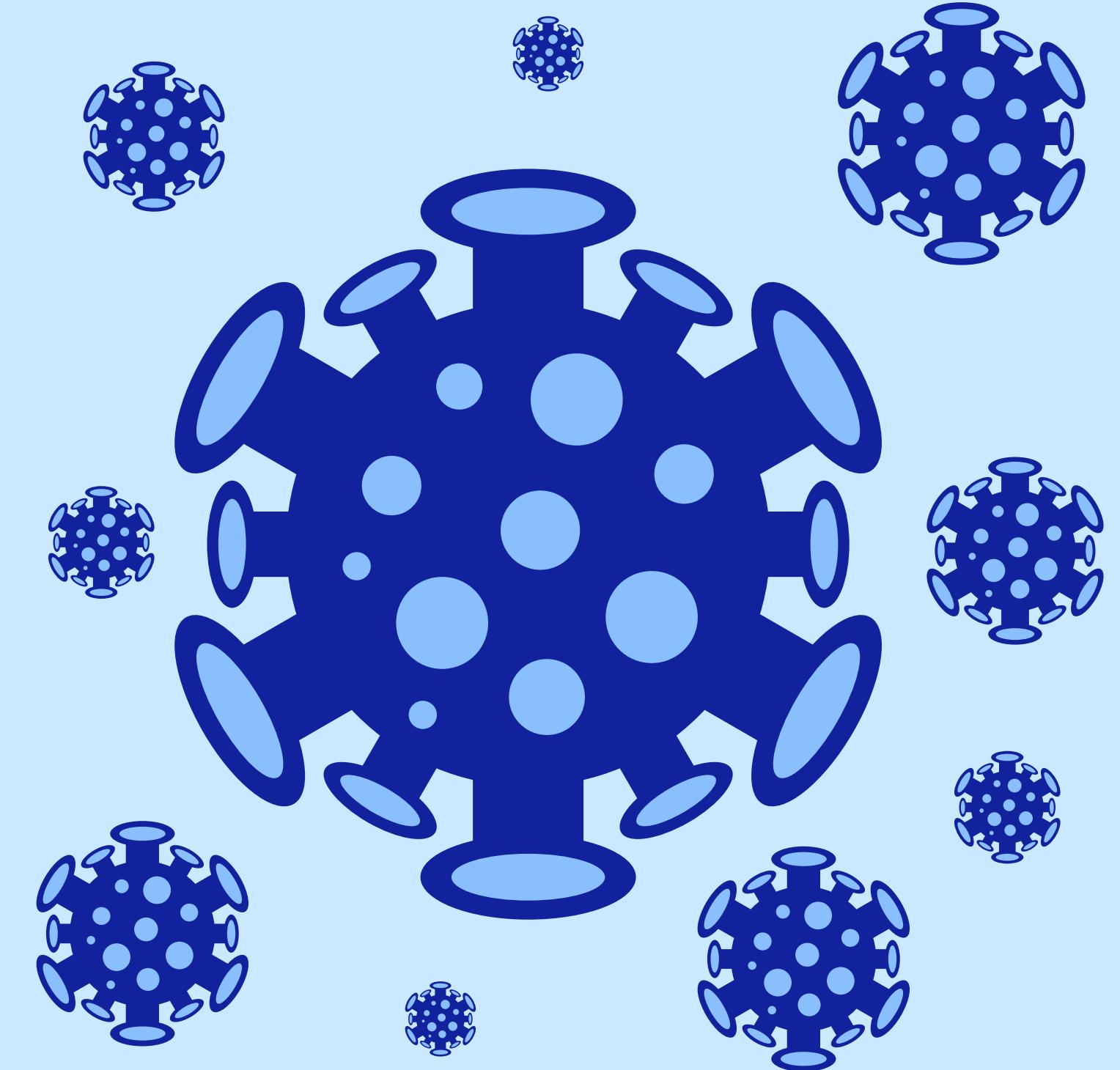
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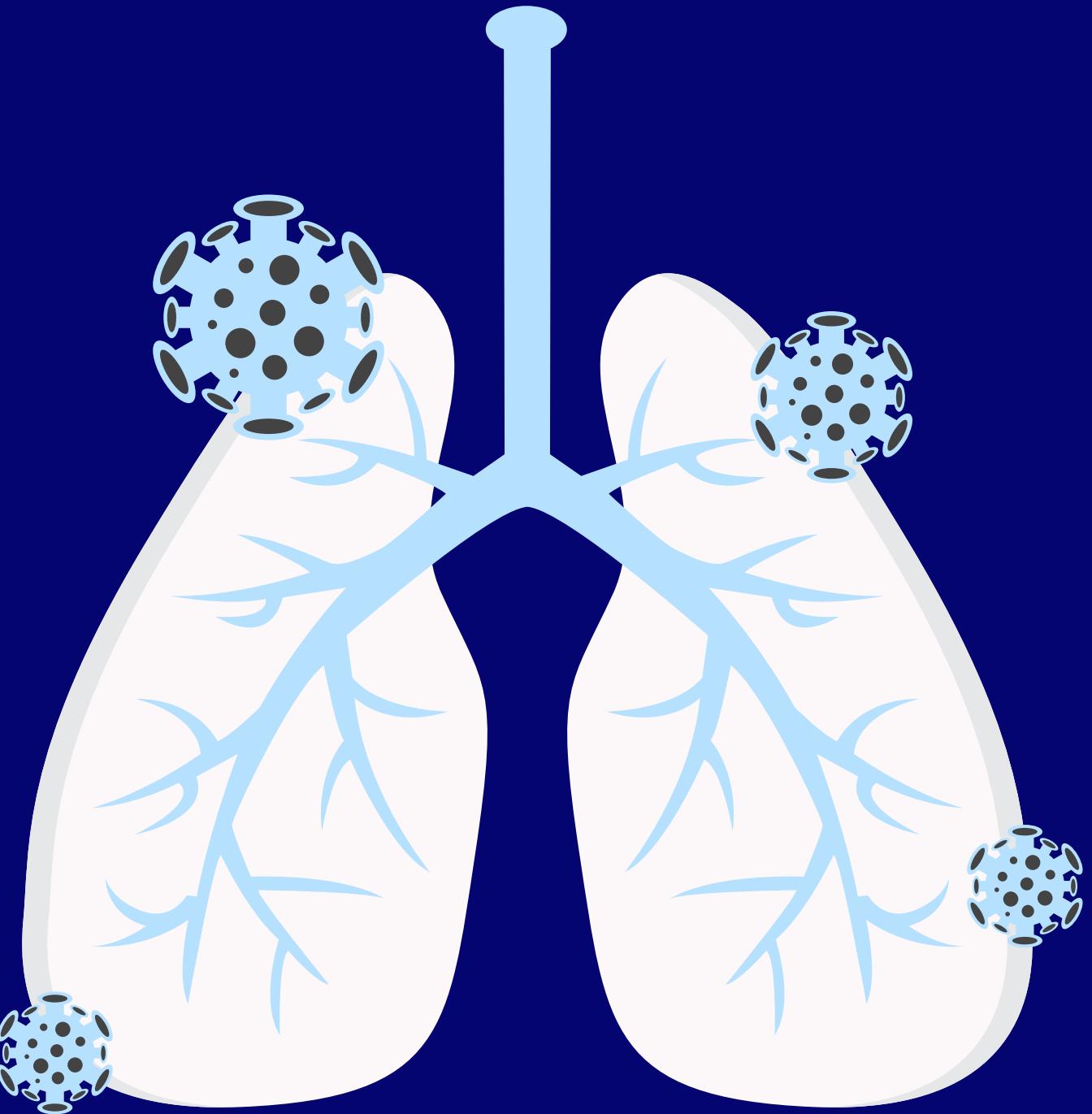
OUTLINE

- Introduction
- Motivation
- Problem statement
- Problem solutions
- Related work
- Data Set
- implementation
- Model Structure
- Methodology
- Technologies
- Time plan



01

INTRODUCTION



★It was discovered recently that COVID_19 affects several organs in the human body, especially the cardiovascular system.

December 2019

March 2020

February 2023

753 million

6.8 million

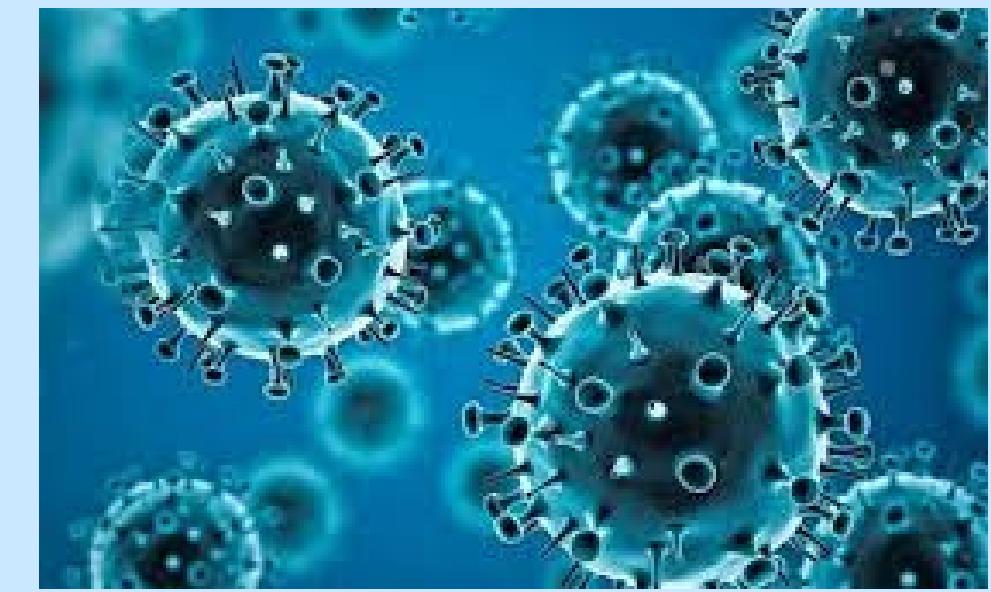
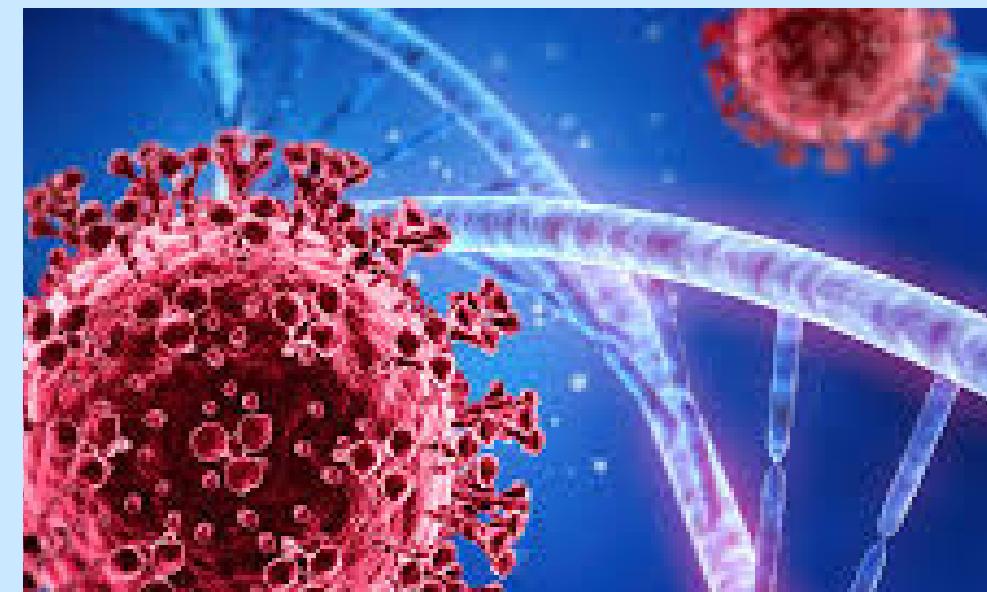
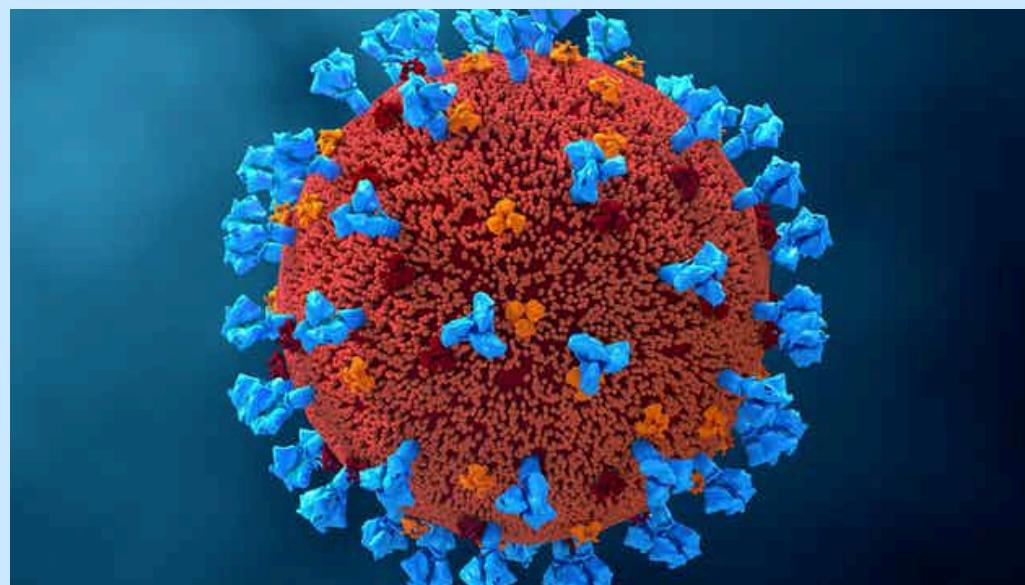
The covid19 first appeared in China

It was noted that the number of deaths worldwide due to this virus was significant

according to a report presented by the World Health Organization

people were infected with this disease

deaths



★ It was estimated by the World Health Organization (WHO) in February 2023 that more than 17.9 million people are dying due to CVD

SOME OF THE DISEASES THAT CAN AFFECT THE HEART INCLUDE:

- Heart attack
- Myocarditis (inflammation of the heart muscle)
- Arrhythmias (heart rhythm disorders)
- Cardiomyopathy (enlargement of the heart muscle)



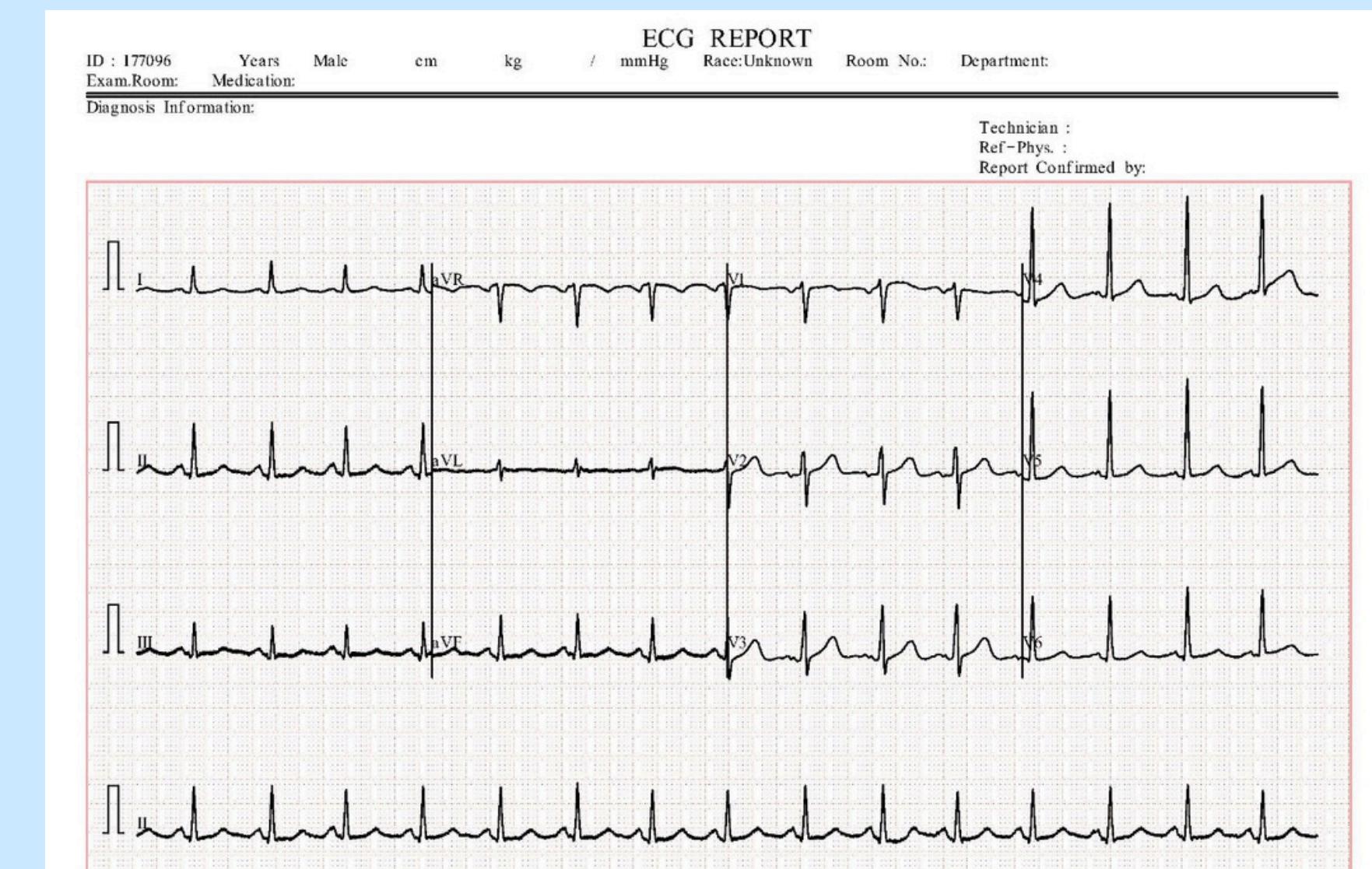
02

Motivation



★ The motivation behind developing an application using ECG image for diagnosing heart diseases and COVID-19 is to enhance early diagnosis and provide effective healthcare.

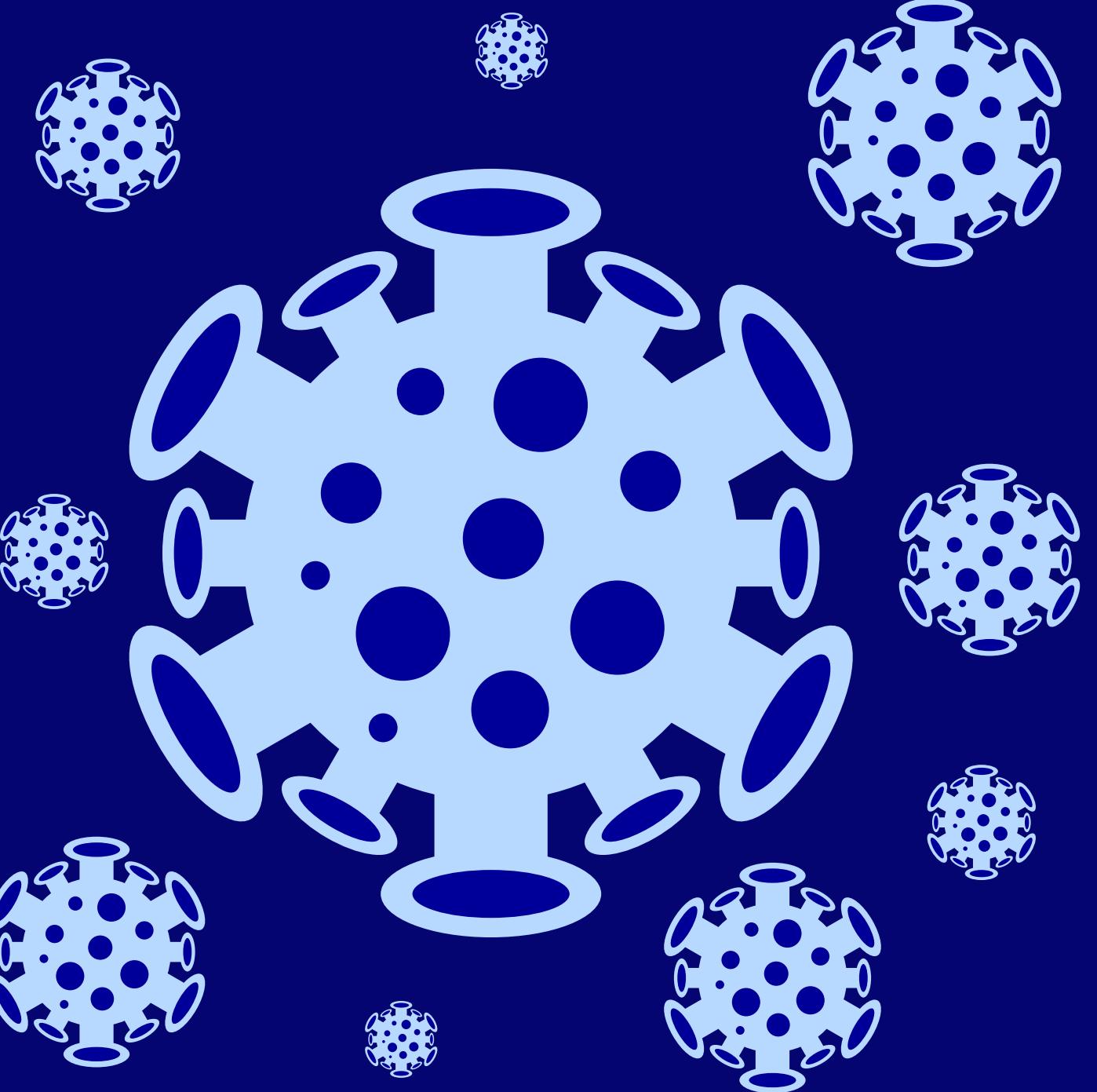
★ This technology aids in identifying precise changes in heart activity, capturing early signs of heart diseases, and understanding the cardiac effects of the coronavirus.



- ★ This contributes to quicker treatment decisions, improving recovery chances, and enhancing preventive measures
- ★ The goal is to develop a simple and effective diagnostic tool using artificial intelligence technology, to assist doctors in diagnosing cases more quickly and accurately.

03

PROBLEM STATEMENT



One of the problems users face when they need to diagnose whether they are infected with the coronavirus or have a heart condition is that they have two protocols to choose from.

01

The first protocol is **PCR**, which provides quick but less accurate results.

02

The second protocol involves **lung imaging**, which is costly, time-consuming, and requires a doctor's intervention



Both protocols have their advantages, but they also have drawbacks. Therefore, it is important for us to develop a new protocol that assists users in diagnosis.

04

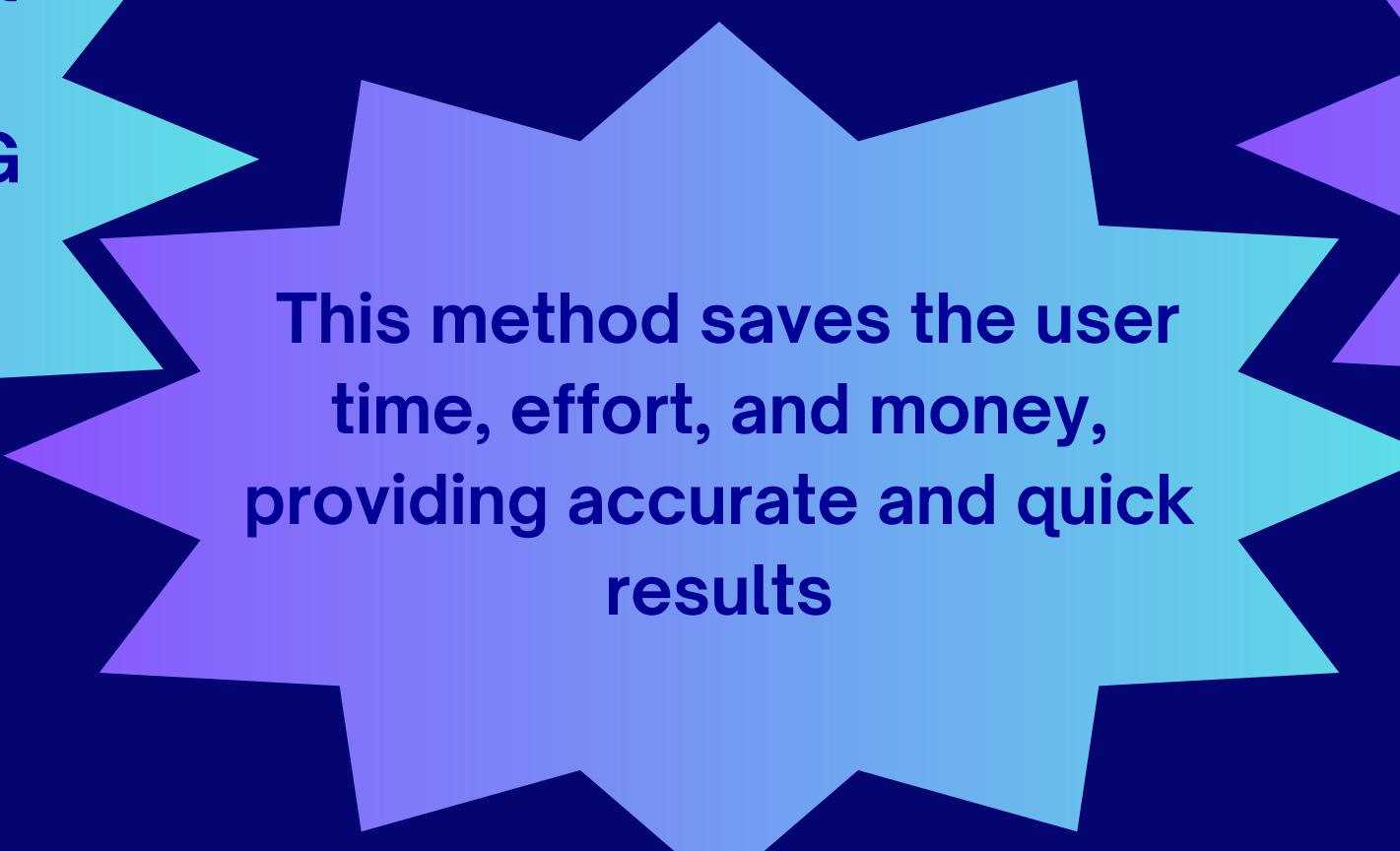
PROBLEM SOLUTION



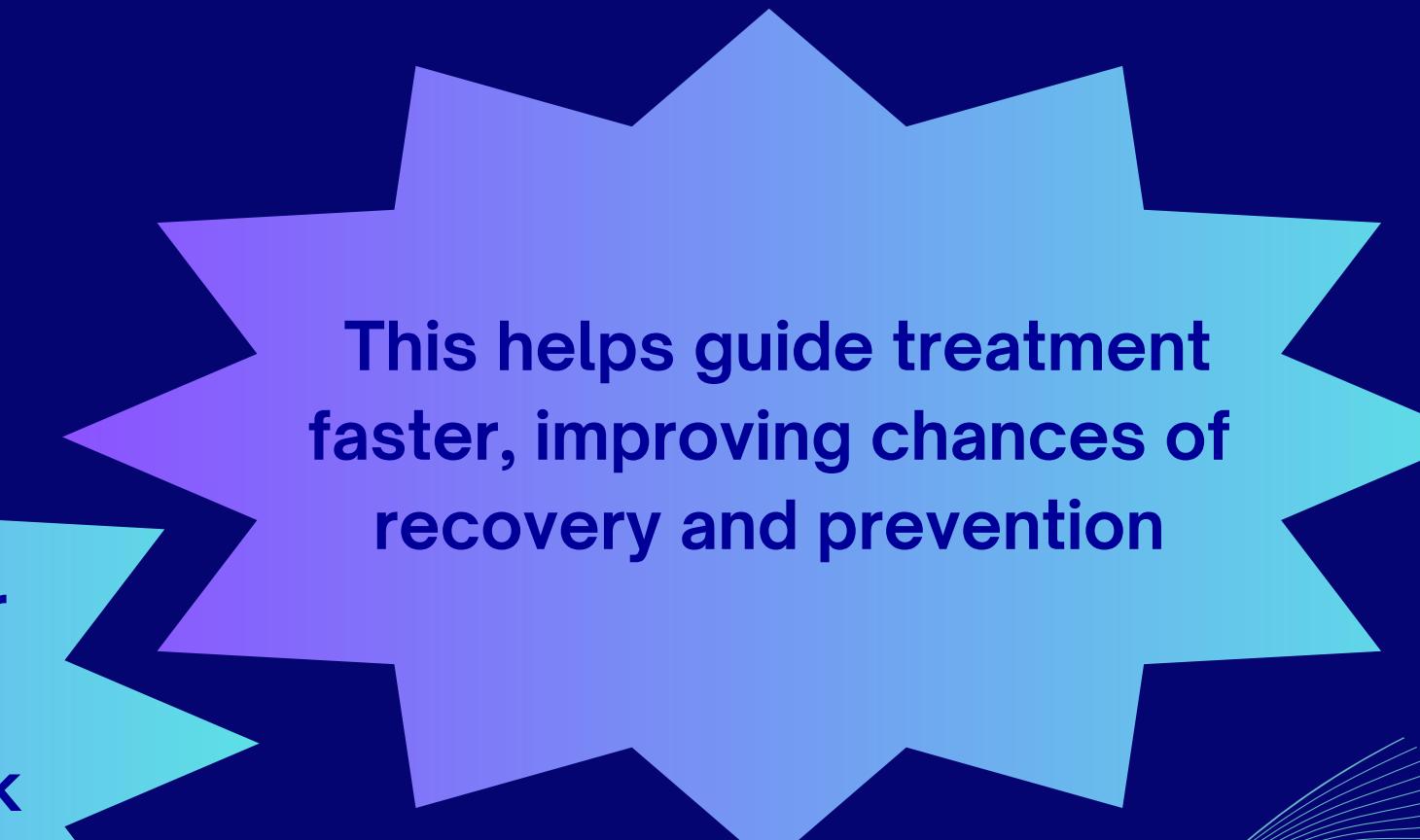
SOLUTION



we developed a website that assists users in diagnosing these diseases by using ECG images



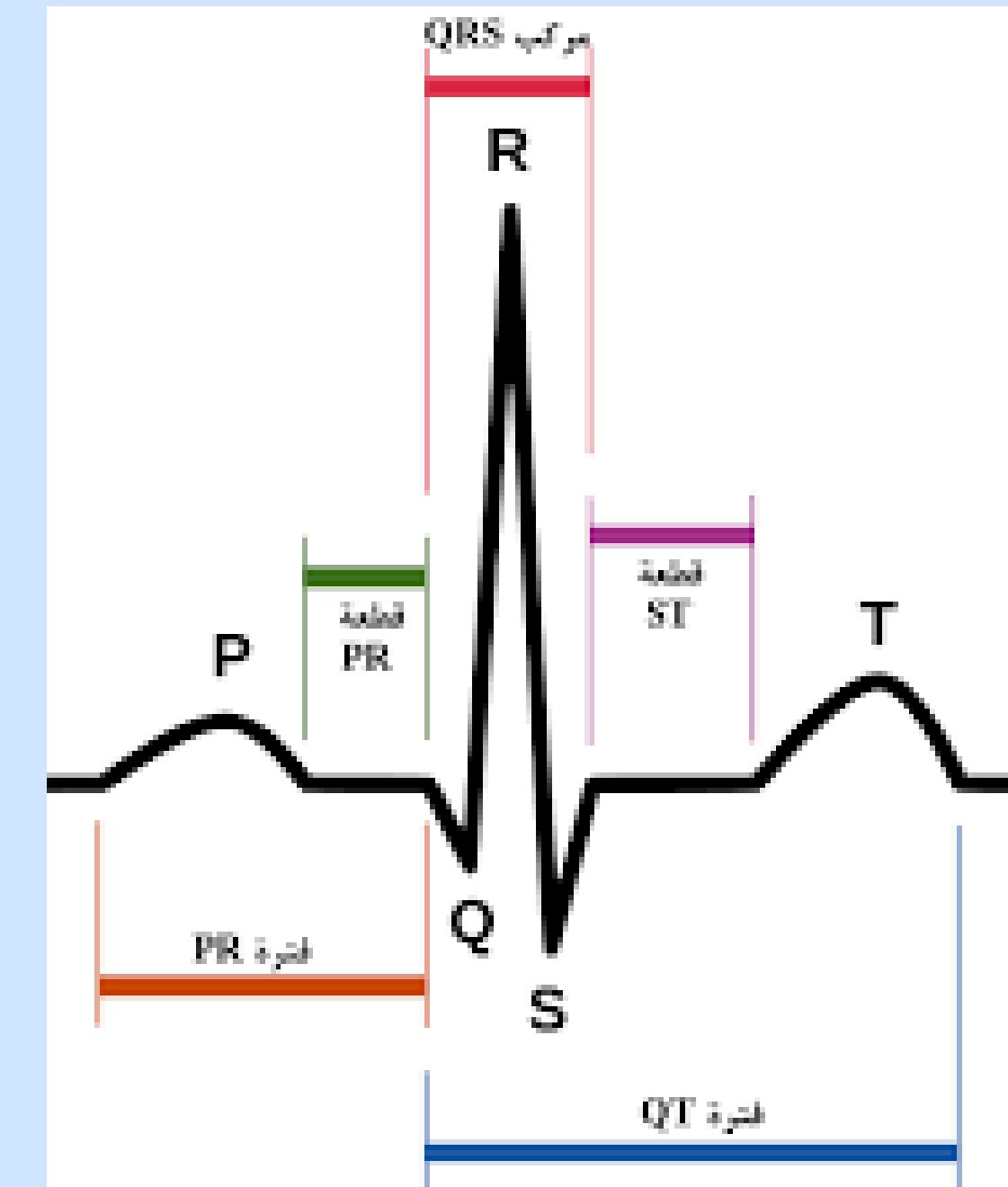
This method saves the user time, effort, and money, providing accurate and quick results



This helps guide treatment faster, improving chances of recovery and prevention

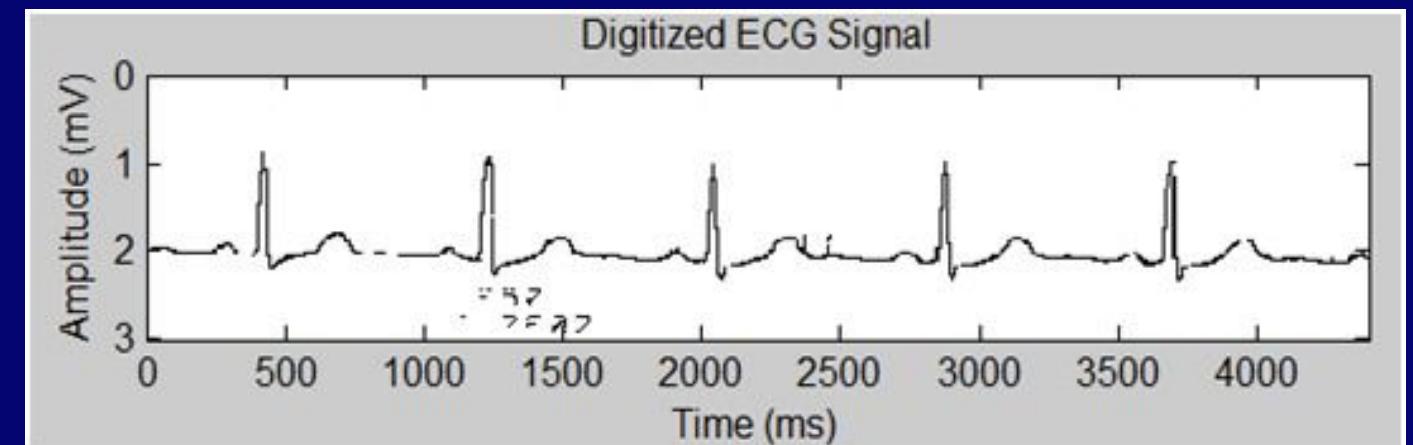
Electrocardiogram (ECG Signals)

- ★ **(ECG)** signals are considered one of the most important attributes for continuous monitoring of the human health.
- ★ The **ECG** signal consists of five main peaks which are the **P**, **Q**, **R**, **S**, and **T**.
- ★ The **ECG** technology depends on the electrical impulses of the heart.



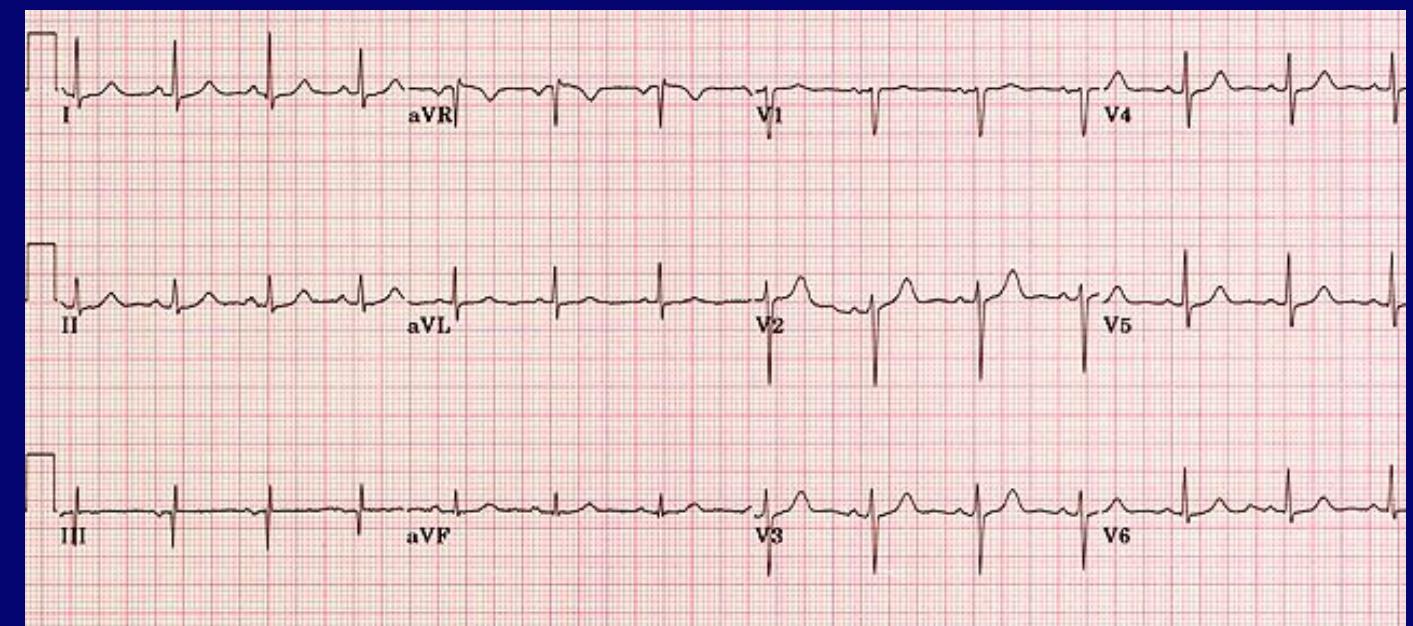
Electrocardiogram (ECG Image)

★ ECG can be represented in various shapes. One of these shapes is the digitized form of the ECG.



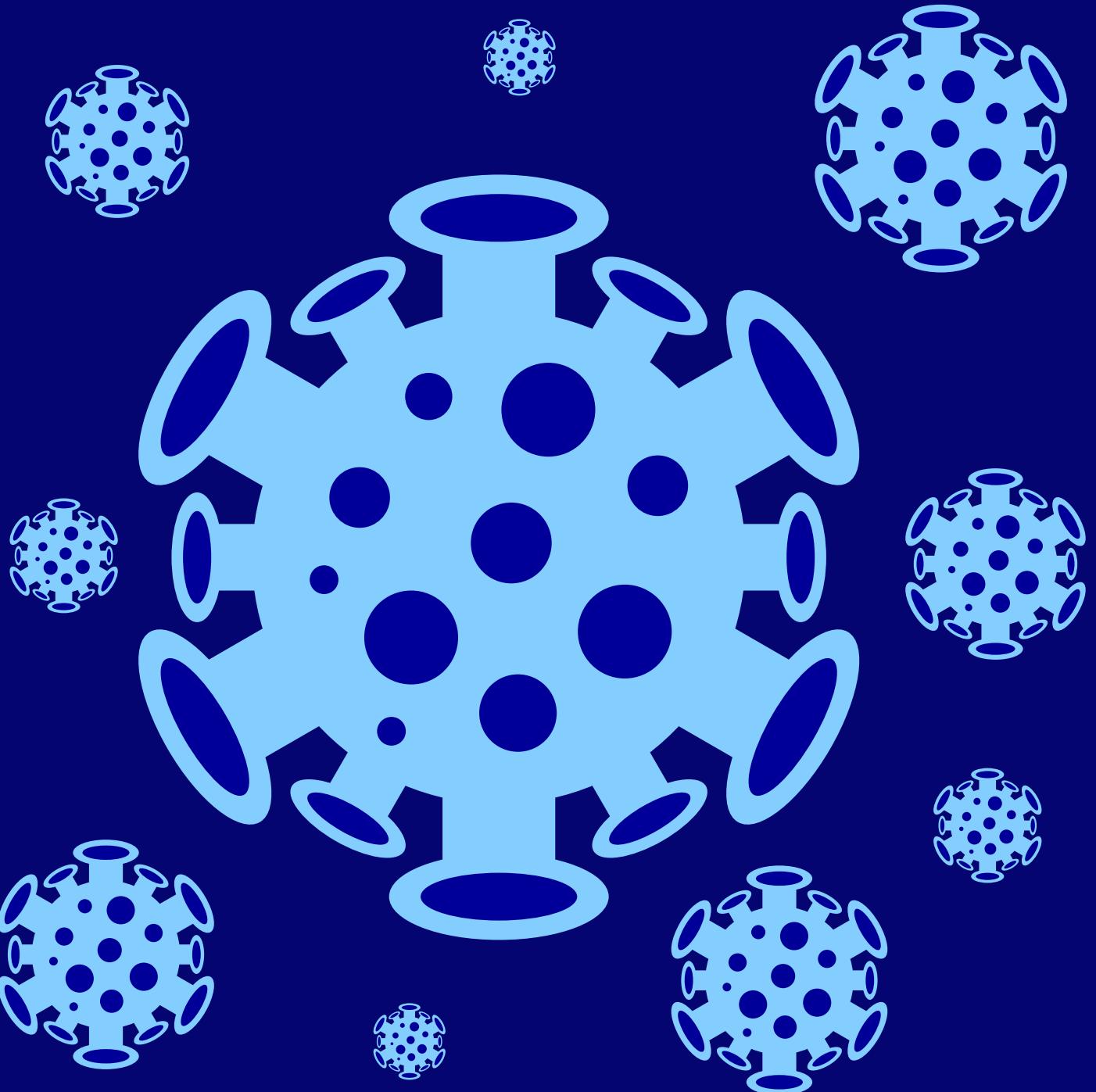
★ Another shape or form that describes the ECG is the ECG graph or the ECG tracing.

★ ECG paper reports are printed in the form of graph paper to achieve an accurate interpretation



05

Related work



Authors	No classes and leads	Types of ECG classes	Number of ECG image Reports or Recorded Images	Methodology	Results
Hao et al. 2019	2 classes 12 ECG leads	Normal vs MI	1557 ECG image reports	Text detection of lead label + shallow neural network + depth fusion	Train and validation: 957 Test: 600 A= 94.73 % Sen = 96.41% Spec = 95.94% F1-Score = 93.79%
Ferreira et al. 2019	2 classes 12 ECG leads	Normal vs Abnormal	100673 image samples	LBP + MLP	A = 96.18%
OurTeam	5 Class	Normal Abnrmal Mycrocardial History of Microcardial Covid_19	8350 Images	Mask and CNN Modal (inception_v3)	Train=97.5% Test=97.2% Validation=97.7%
Gliner et al. 2020	8-classes 12- ECG leads	AF, I-AVB, LBBB, RBBB, PAC, PVC, STD, and STE	41830 Digital and Image leads	CNN-ima and CNN-dig	Training and validation = 86% Testing = 14% A = 88%

Authors	Methodology	Experiments	Results
Anwar et al. 2021	EfficientB0 + Softmax	<p>Multi-Class Experiment COVID (250) vs MI (77) vs PMI (203) vs Abnormal (548) vs Normal (859)</p>	<p>Five-Fold Cross-validation A = 81.8 without augmentation A = 77.6 with augmentation</p>
Shahin et al. 2021	Vgg16 + Softmax	<p>Multi-Class Experiment 5- class diagnosis COVID (250) vs MI (77) vs PMI (203) vs Abnormal (548) vs Normal (859)</p>	<p>K-Fold Cross-validation A = 81.39</p>
Rahman et al. 2022	DenseNet201 + Softmax	<p>Multi-Class Experiments 1st: COVID (250) vs MI (77) vs PMI (203) vs Abnormal (548) vs Normal (859) 2nd: COVID (250) vs Normal (250) vs Abnormalities (250) Binary-Class Experiment 3rd: COVID (250) vs Normal (250)</p>	<p>10-Fold cross-validation 1st: A= 97.83 2nd: A = 97.36 3rd: A= 99.10</p>
Attallah 2021	<p>Fully connected features of 5 pre-trained models + DWT of the max-pooling features + 3 classifiers</p>	<p>1st: COVID (250) vs Normal (250) vs Abnormalities (250) Binary-Class Experiment 2nd: COVID (250) vs Normal (250)</p>	<p>10-Fold Cross-validation 1st: A = 91.73% 2st: A = 98.80% Using voting classifier</p>

06

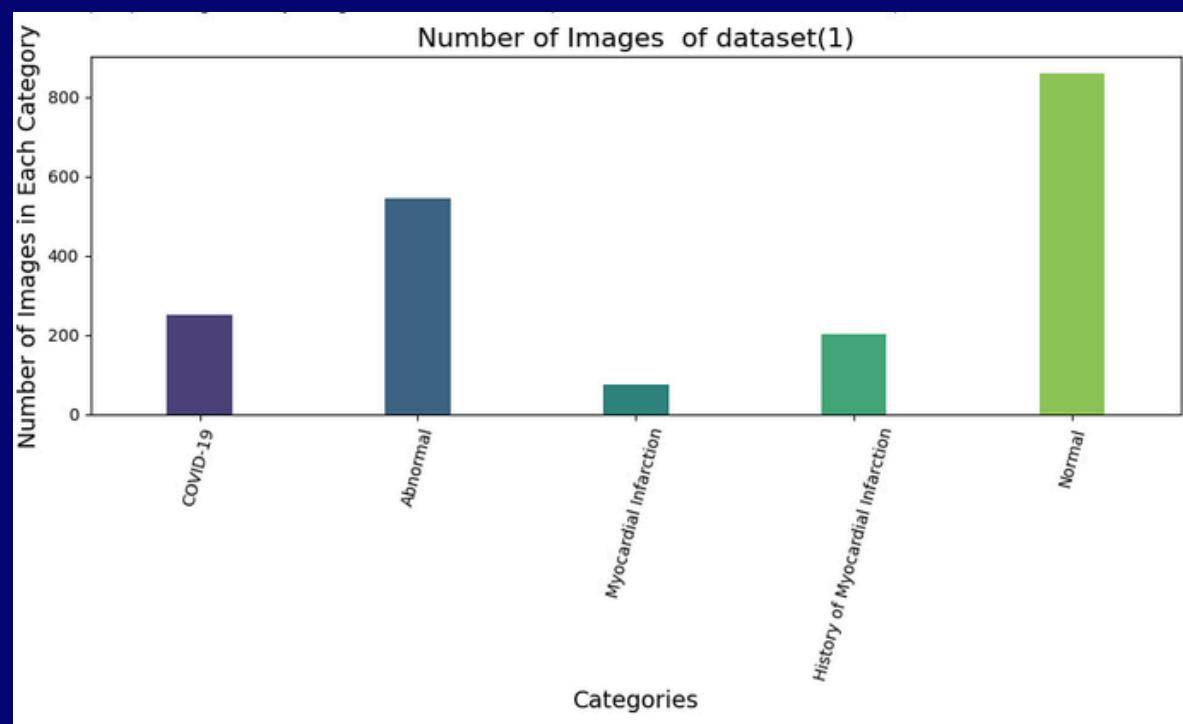
DATASET



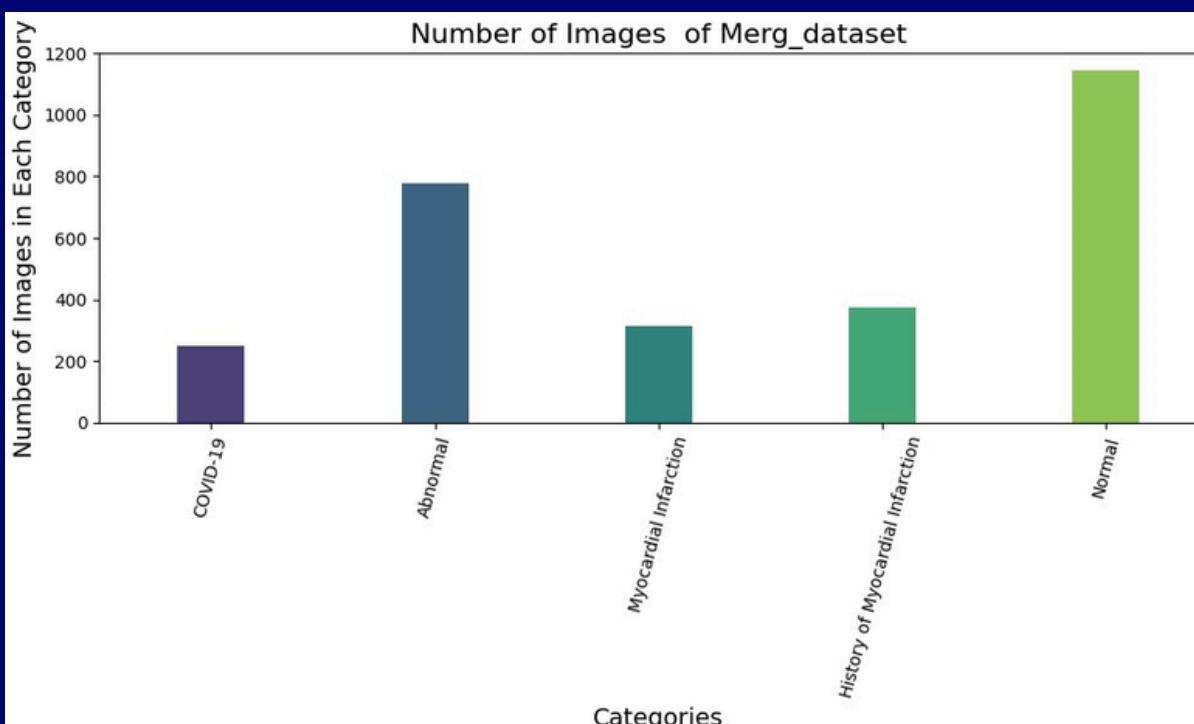
Dataset Information

Our dataset consists of five types of ECG (Electrocardiogram) images.

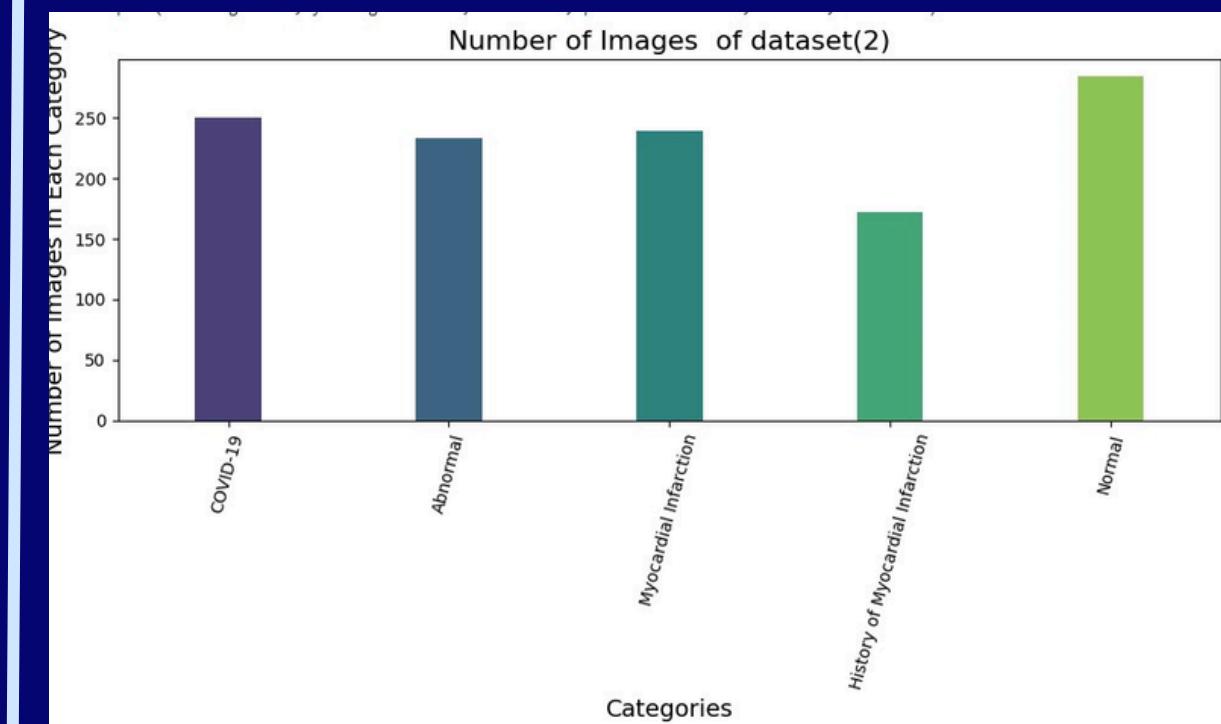
Dataset(1)



Merg Dataset



Dataset(2)



Total Number of ECG Images is 1932

Total Number of ECG Images is 2860

Total Number of ECG Images is 1178

- This dataset consists of ECG images collected from two countries China and Pakistan.

07

IMPLEMENTATION



Image preprocessing

is the first step in implementing the model, where we prepare the data by applying image filters to improve the quality and suitability of the images for the deep learning algorithm.

Image preprocessing



Image Preprocessing

1-Remove Noise

Removing noise from images is a crucial step in image processing to improve the overall quality and clarity of an image

Noise in images refers to random variations or unwanted disturbances in pixel values, often introduced during image acquisition , transmission, or processing.

To enhance the accuracy of our image processing, we must address the noise present in the header and footer. This noise can take the form of text, logos, or other visual elements that are not part of the main image content.



TECHNOLOGY USED FOR REMOVING NOISE



we use
Bilateral Filtering to
remove noise

01
is a non-linear method that smoothens

02
the image while preserving edges.

03
It considers both spatial closeness and intensity similarity.

Image Preprocessing

2-Remove Background

This process is essential to enhance the visibility of key information within ECG images, improve analysis accuracy, and facilitate the classification of patterns present in ECG.

Removing the background is necessary to enhance the performance of models.

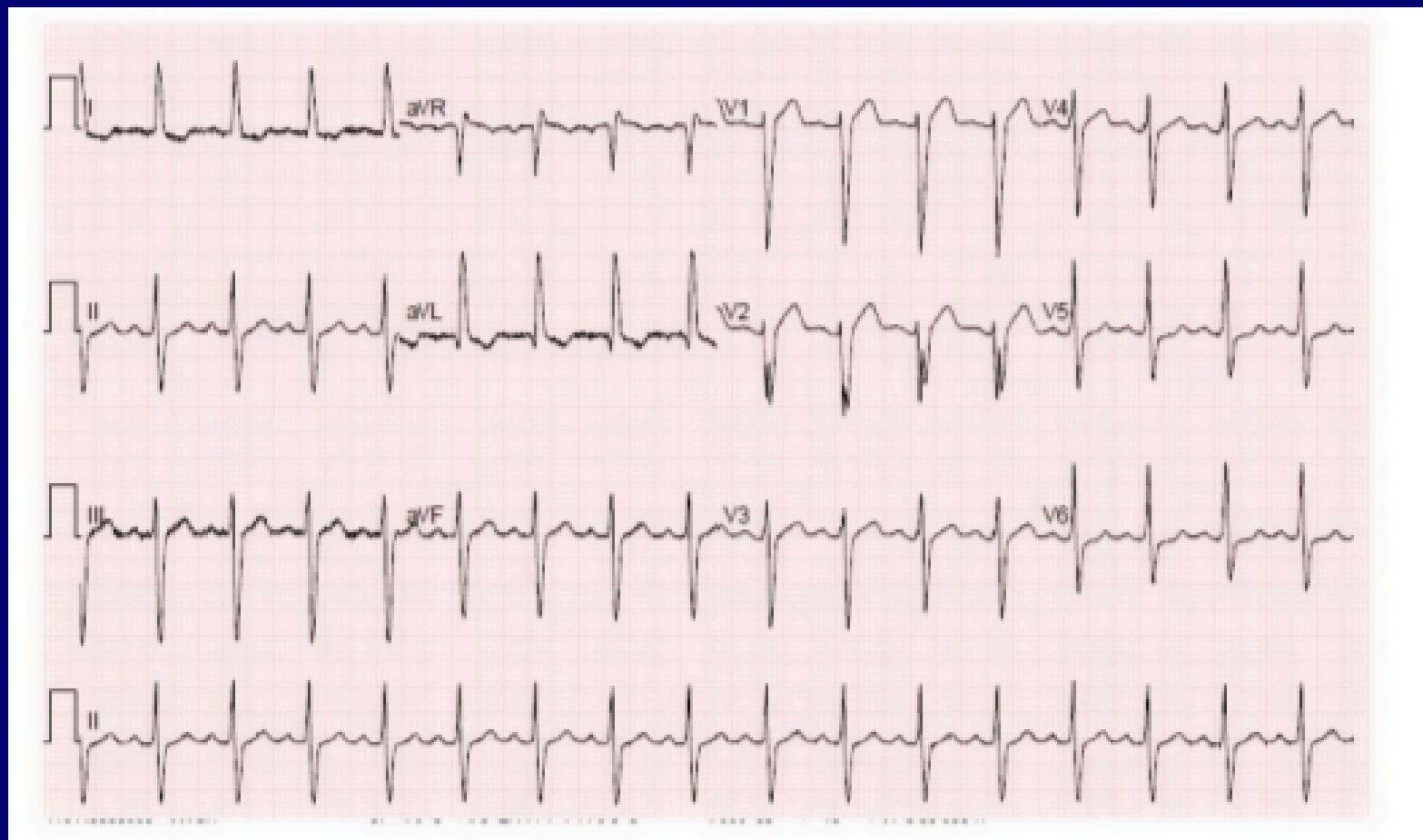
Technology used to Removing background

1- Segmentation

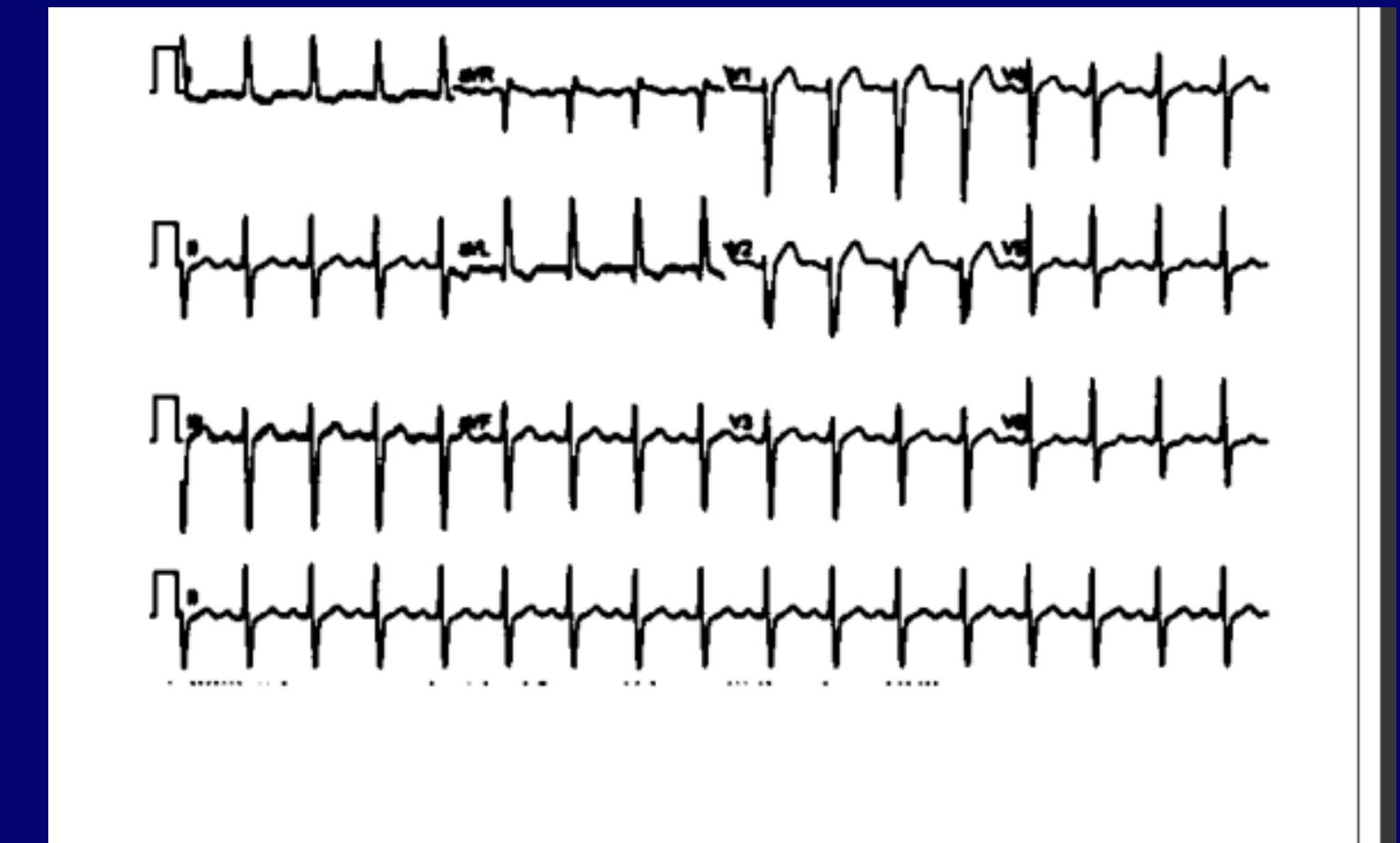
is attempts to partition the pixels of an image into groups that strongly correlate with the objects in an image Then it's easy to extract it from a background

In the process of segmentation, type of thresholds are used

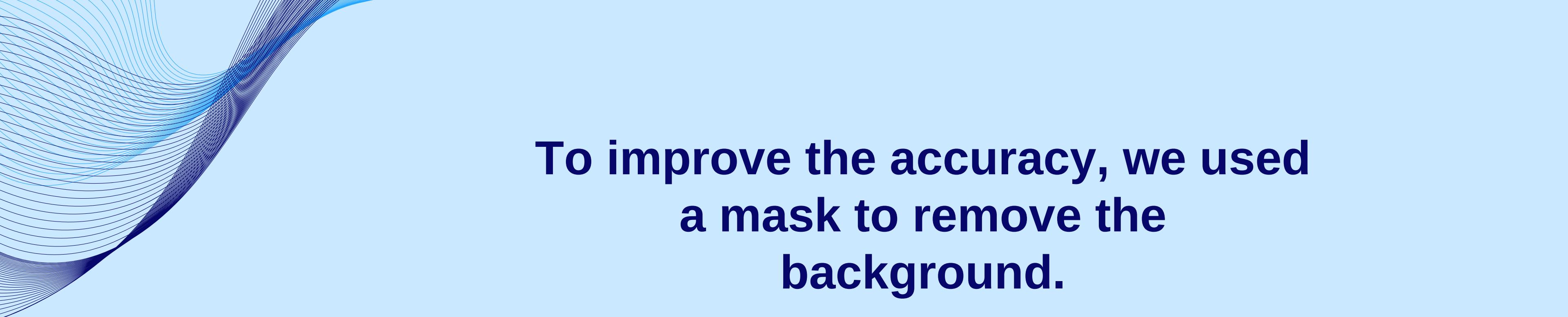
binary with Otsu's



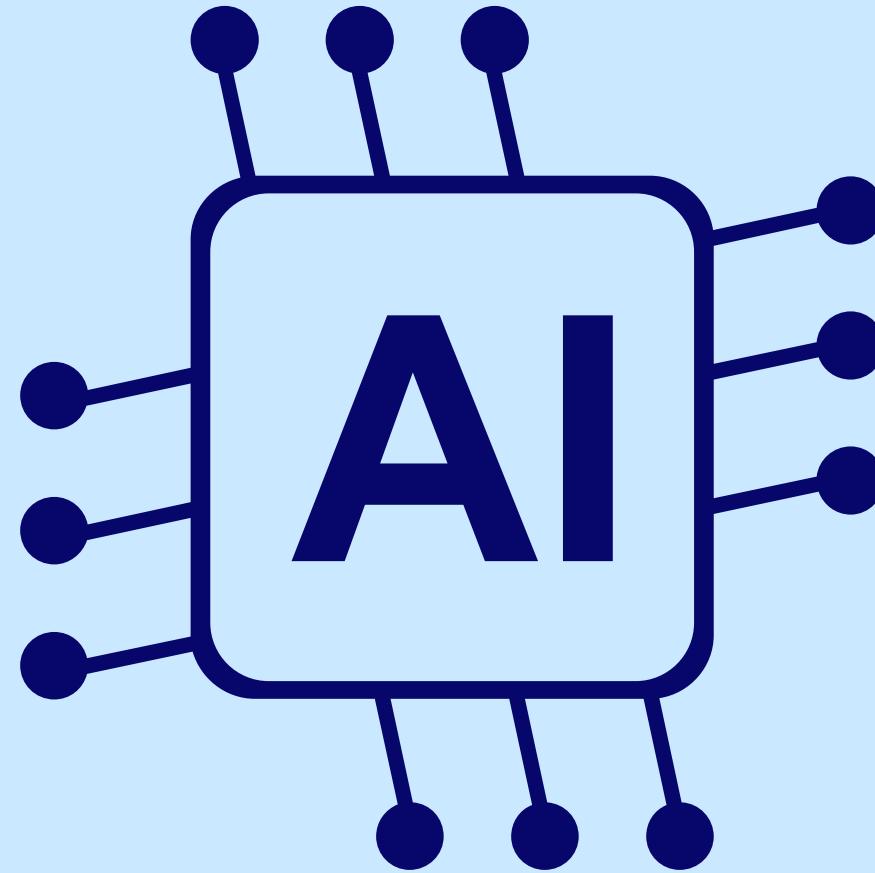
Before



After



To improve the accuracy, we used a mask to remove the background.



2- mask

is a binary image used to identify specific parts of another image. The values in the mask are either 0 (black) or 255 (white), where white represents the areas we want to keep or process, and black represents the areas we want to ignore or exclude.



steps to create the mask

01

Define the white color range:

We define the range of white color using NumPy arrays. Here, we consider colors between [50, 50, 50] and [255, 255, 255] as white.

02

Create a mask:

A mask is created using the cv2.inRange function, which identifies the white parts of the image.

03

Improve the mask:

We use morphological opening to remove small white points from the mask for better results. A structuring element in the shape of an ellipse with a size of 3x3 pixels is used.

04

Invert the mask:

The mask is inverted so that non-white areas are retained.

05

Create a white background:

A completely white image of the same size as the original is created.

06

Apply the mask to the original image:

The inverted mask is applied to the original image, keeping only the non-white parts.

steps to create the mask

07

Invert the mask again

08

Apply the mask to the white background:

The mask is inverted (again) and applied to the white background, turning the white areas of the original image into white.

09

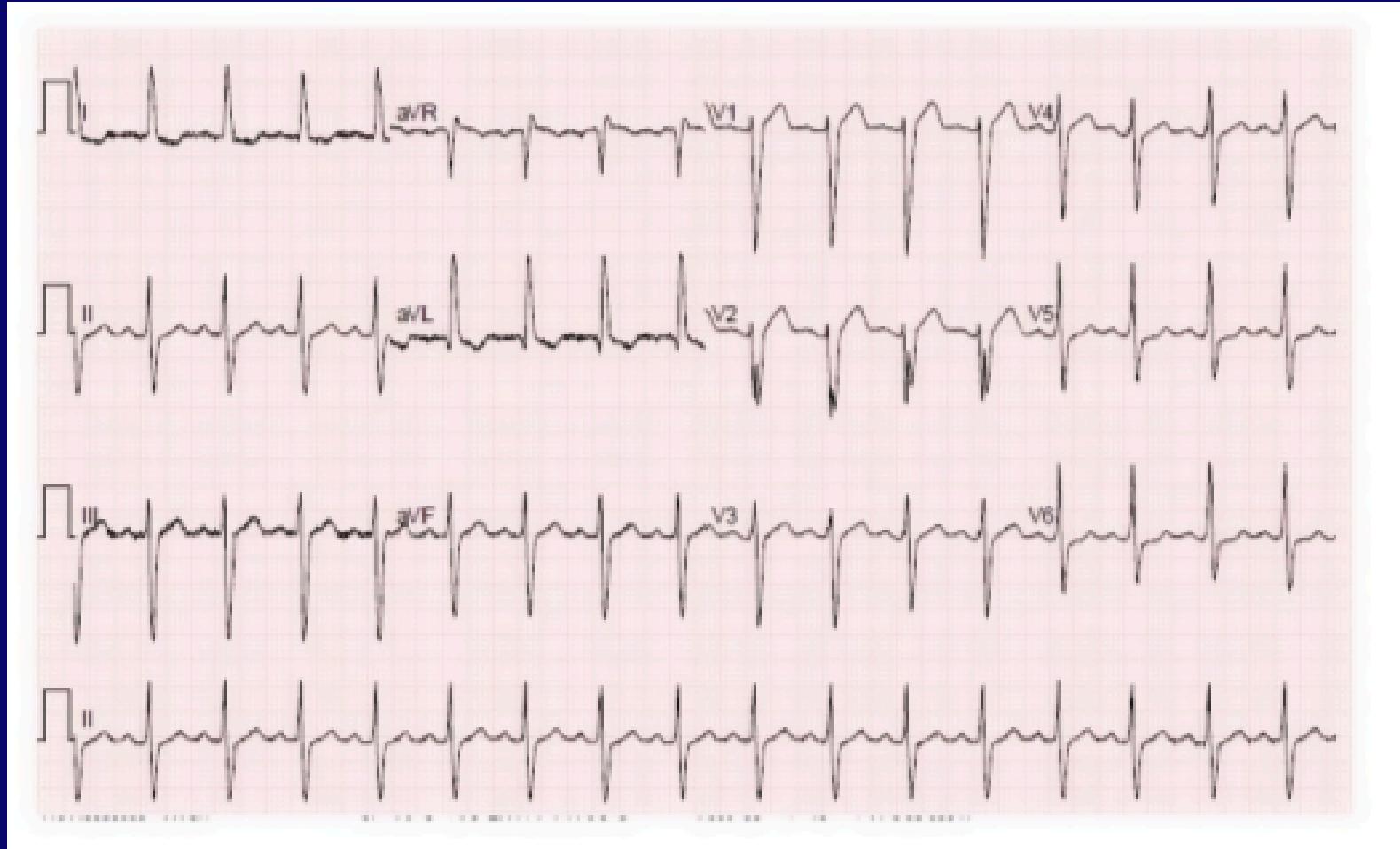
Combine the results:

The preserved parts of the original image and the white background are combined using the bitwise "or" operation.

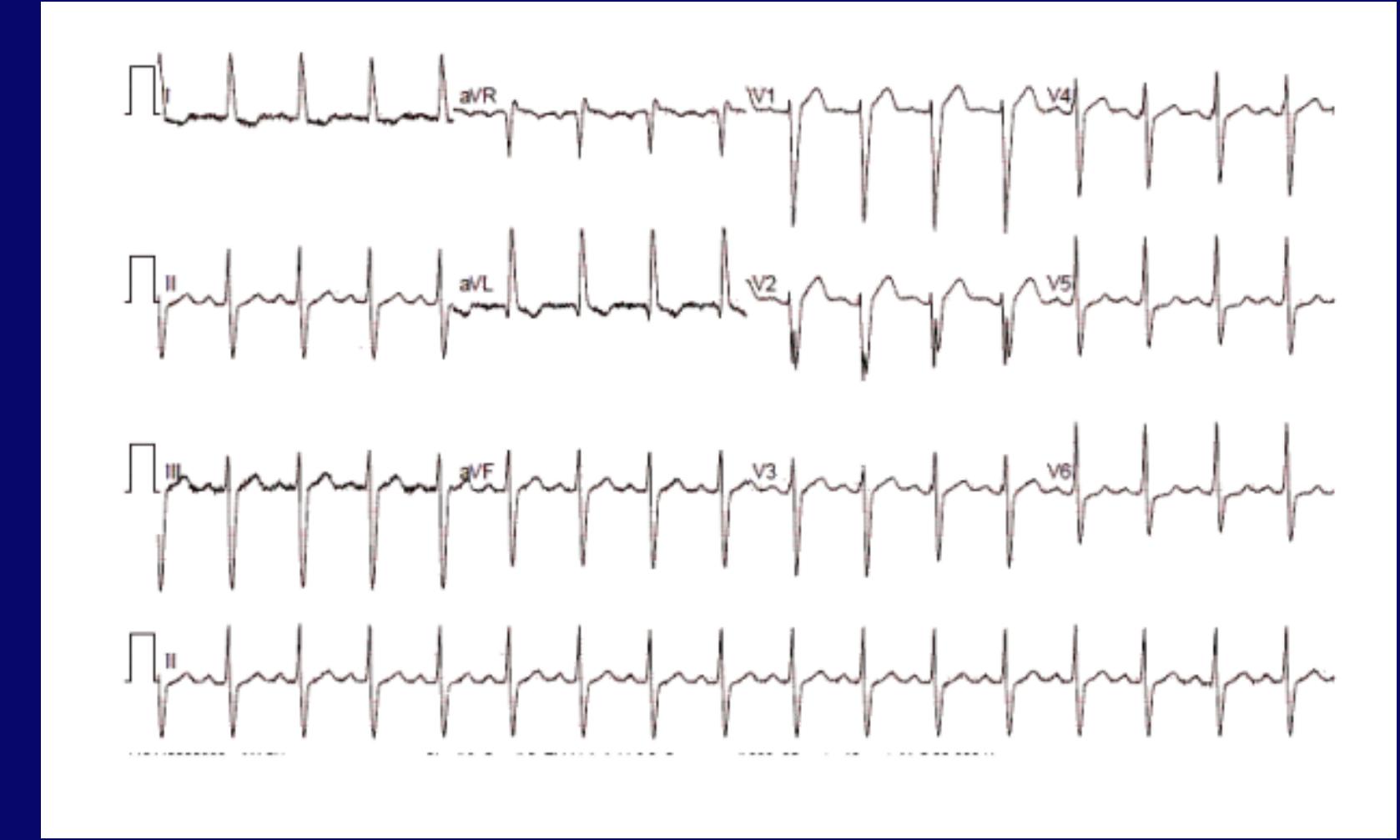
10

Invert the mask to save the results:

The final image (final.jpg) and the mask (mask.jpg) are saved to disk.



Before



After

Image Preprocessing

3. Resizing

Image resizing adjusts the dimensions of an image for consistency and efficiency in machine learning models, enhancing performance and resource management.

4. Rescaling

Rescaling is adjusting data to a common scale, crucial for equal feature influence in machine learning. It enhances algorithm performance and ensures fair analysis.

Image Preprocessing

5. Data Augmentation

Deep learning technique requires much more training data than other machine learning approaches. In case where the data consists of images and not much data is available, image augmentation can be applied to increase the number of training examples and to avoid over fitting.

• Techniques for Data Augmentation:

Image Data Generator Based On Geometric Transformations

Two ways

Deep learning advanced

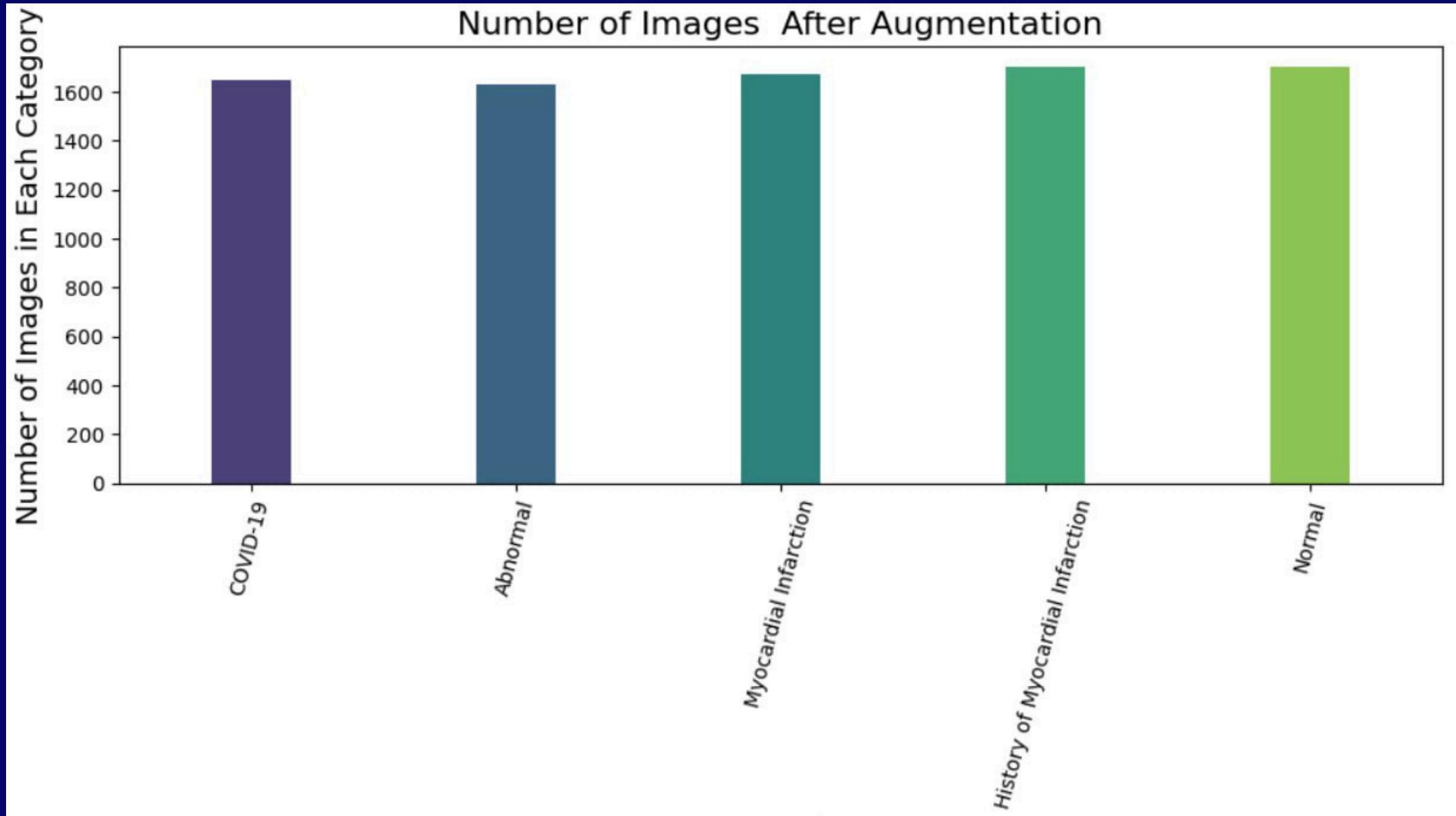
rotation_range=9
zoom_range=0.2
brightness_range=(0.5, 1.5)
horizontal_flip=True
vertical_flip=True
shear_range=0.085
width_shift_range=0.085
height_shift_range=0.085

GAN-based Augmentation: Generative Adversarial Networks (GANs) generate synthetic data that closely resemble real samples, effectively expanding the dataset.



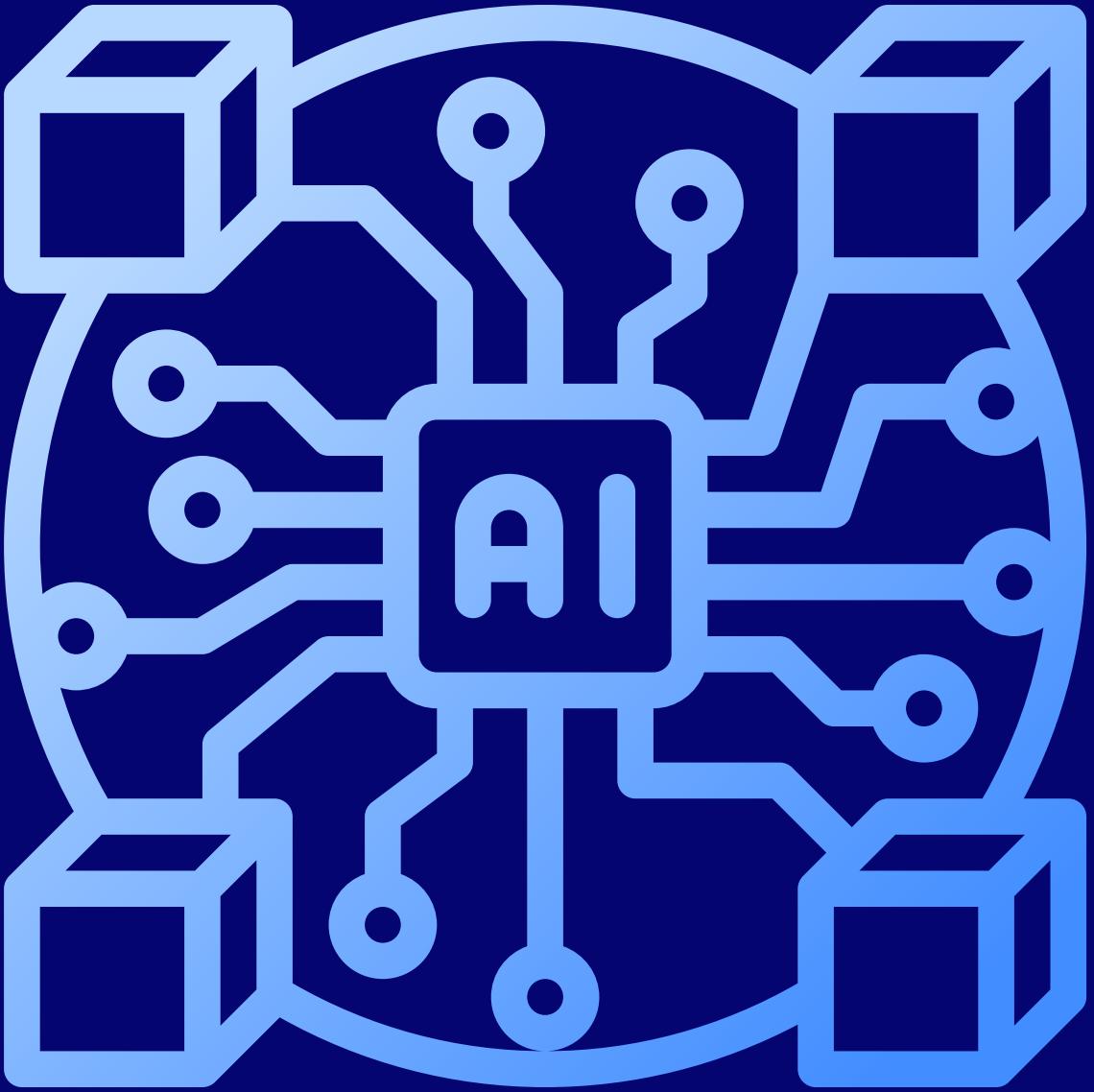
We don't have powerful devices on our team to support GAN technology,

Total Number of
ECG Images is
8350

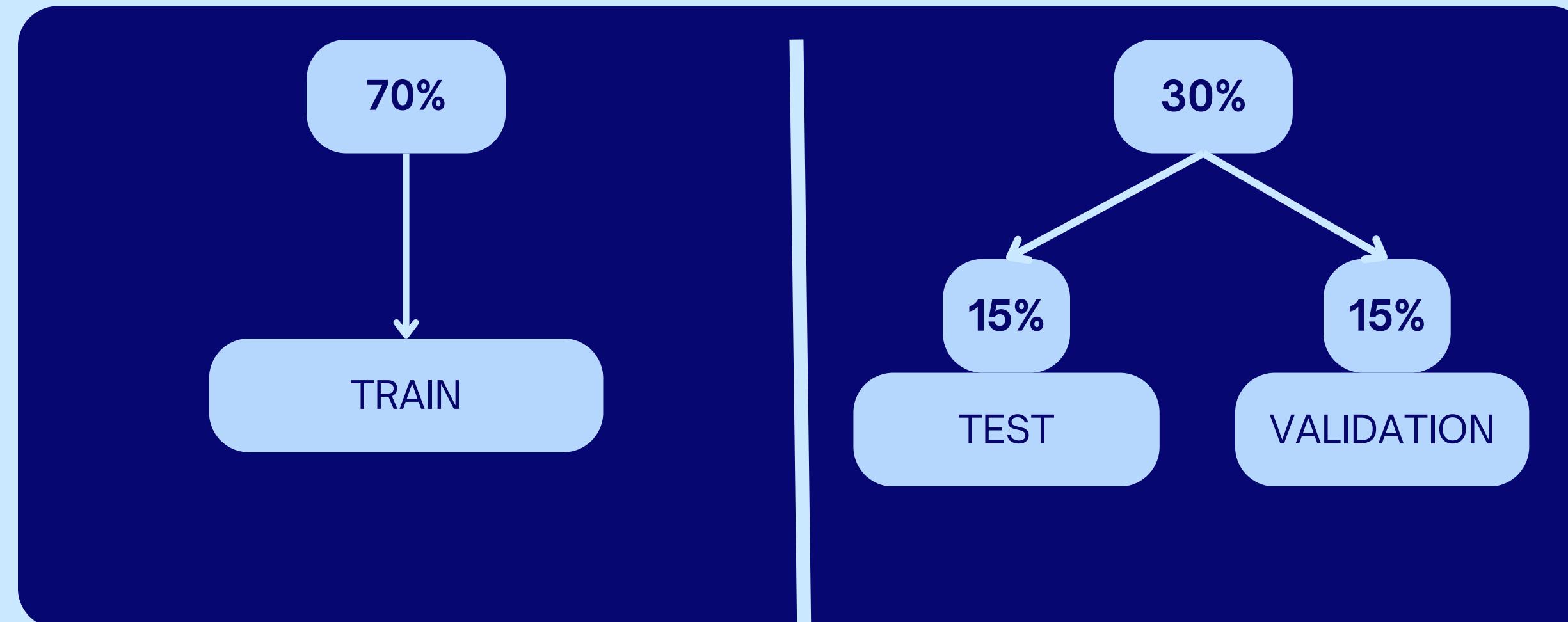


09

Model Structure

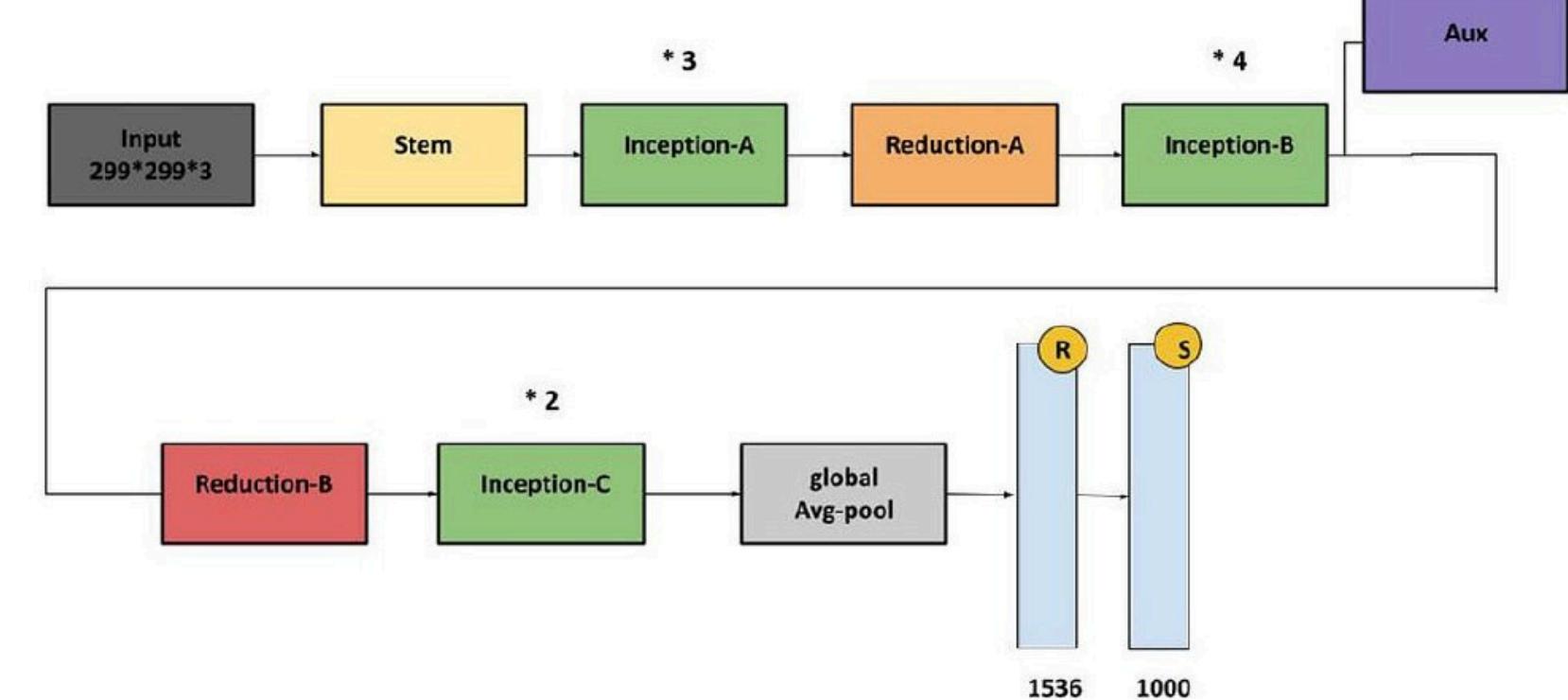


WE DIVIDED THE DATA INTO THREE DATA SETS:



Utilization Model

Inception V3



the Inception V3 network, which is an advanced convolutional neural network (CNN) designed for image processing

Model Structure

input :

The input is an image with dimensions (299 * 299 * 3).

Reduction-A:

A dimension reduction module of type A, aimed at reducing the spatial dimensions (height and width) while increasing the depth (number of channels)

stem :

The initial part of the network processes the input data to prepare it for the subsequent stages.

- It includes multiple convolutional and pooling layers.

Inception-B:

A series of Inception modules of type B, which include various convolutional operations to deepen the network and increase the complexity of the features learned.

inception A:

A series of Inception modules of type A, which combine different convolutional operations (such as (1*1), (3 * 3), and 5 * 5)) to capture various features from the data.

Auxiliary Classifier:

An auxiliary classifier used to provide additional training signals, helping to improve gradient flow during training.

- It consists of several convolutional and pooling layers, followed by a classification layer.

Reduction-B:

A dimension reduction module of type B, further reducing the spatial dimensions and deepening the network

Inception-C:

A series of Inception modules of type C, continuing to apply various convolutional operations to capture more features.

Global Average Pooling:

A global average pooling layer, applied to reduce the spatial dimensions to 1, taking the average across each feature map.
- Outputs a number of features equal to the number of channels.

Fully Connected Layers:

Fully connected layers applied after global average pooling.

- Include a final layer that outputs probabilities for each class (usually 1000 classes for image classification in ImageNet)

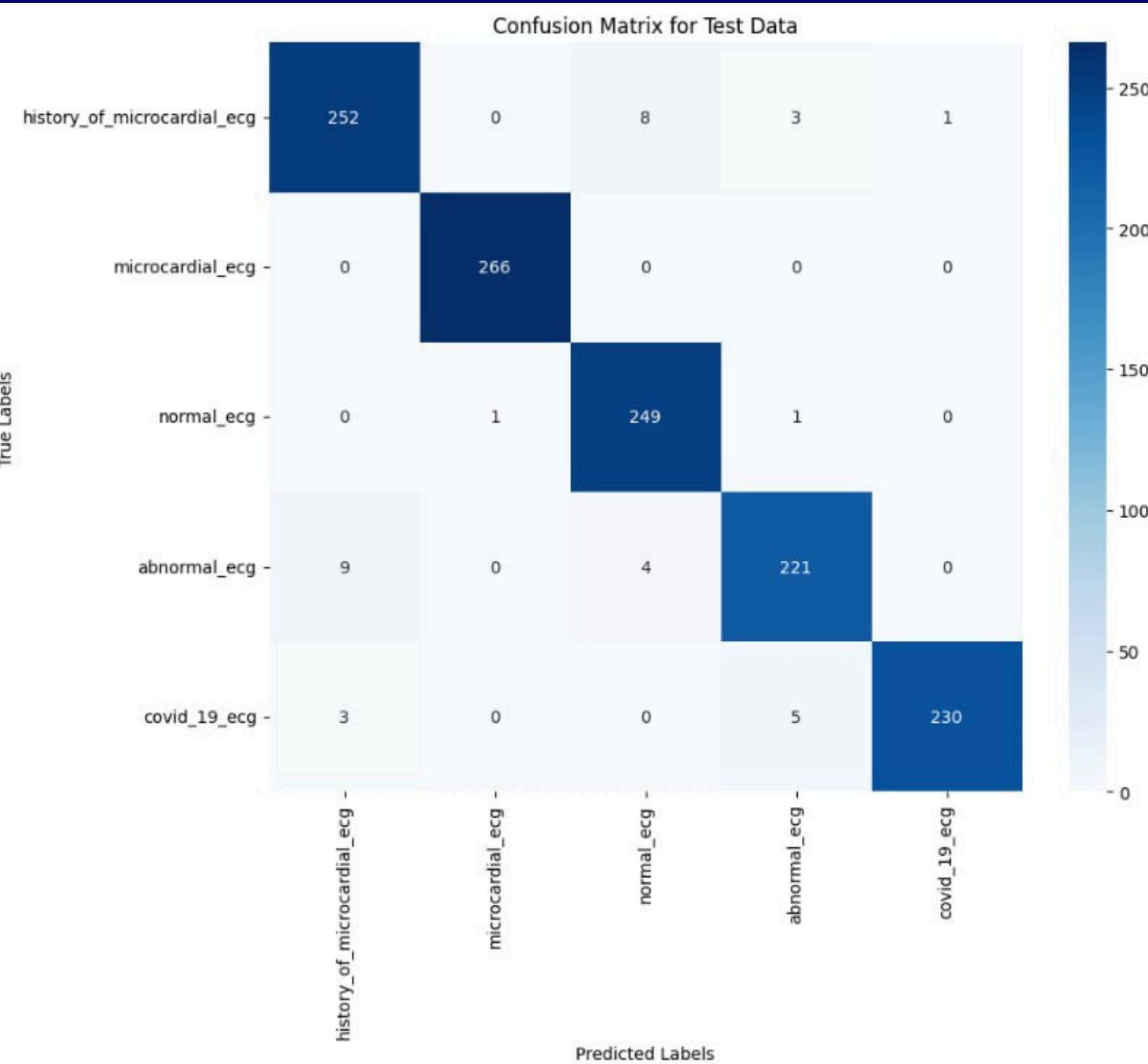
Dropout layer :

use to remove neurons that have noise

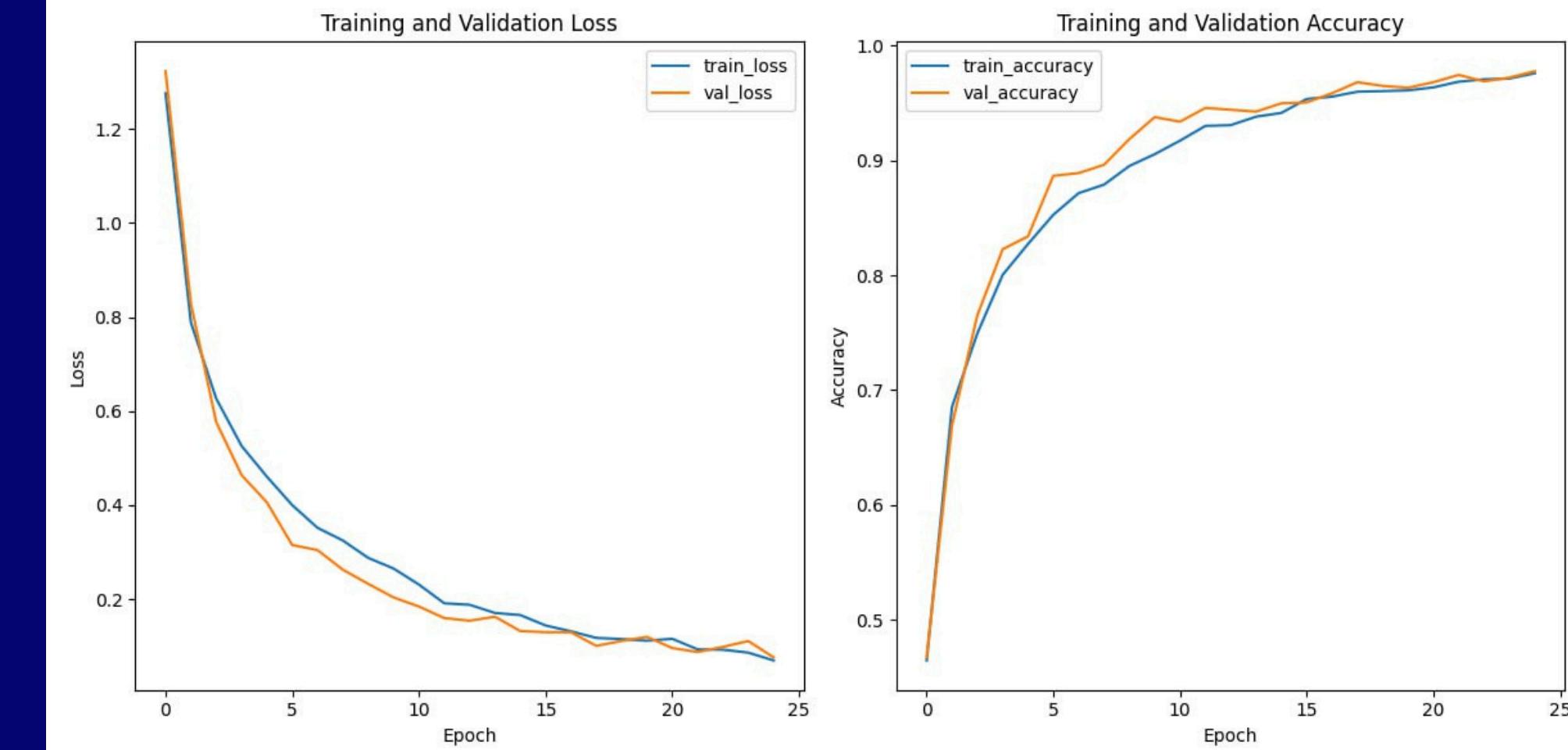
Last fully connected layer:

use 5 neurons to make classification and use softmax classifier

Confusion Matrix



Loss & accuracy



Comprsion between different models

Vgg_19

Accuracy of train : **96%**

Accuracy of test:**95%**

Loss of train:**0.24**

Loss of test:**0.27**

Resenet_50

Accuracy of train : **95%**

Accuracy of test:**94%**

Loss of train:**0.13**

Loss of test:**0.14**

Inception V3

Accuracy of train : **97.5%**

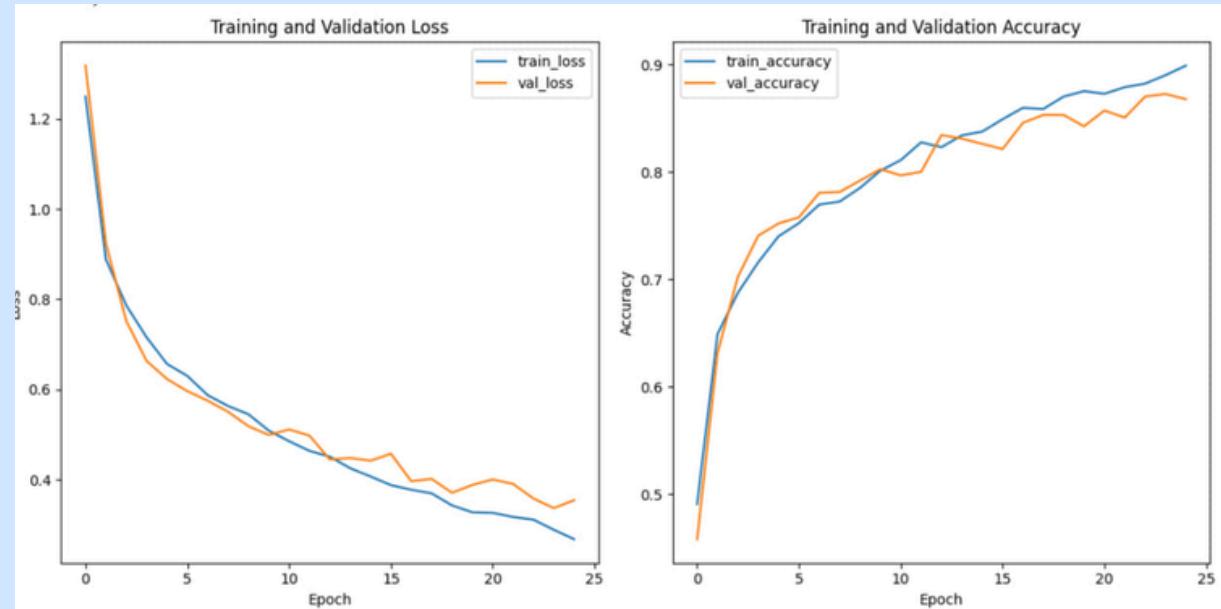
Accuracy of test: **97.2%**

Loss of train:**0.06**

Loss of test:**0.09**

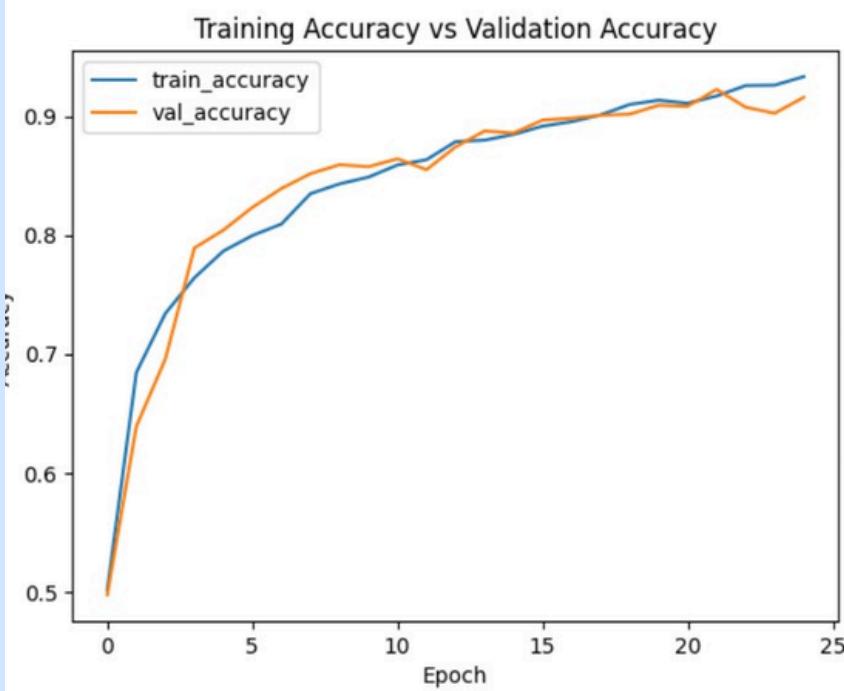
The comparison between two dataset

DataSet.1



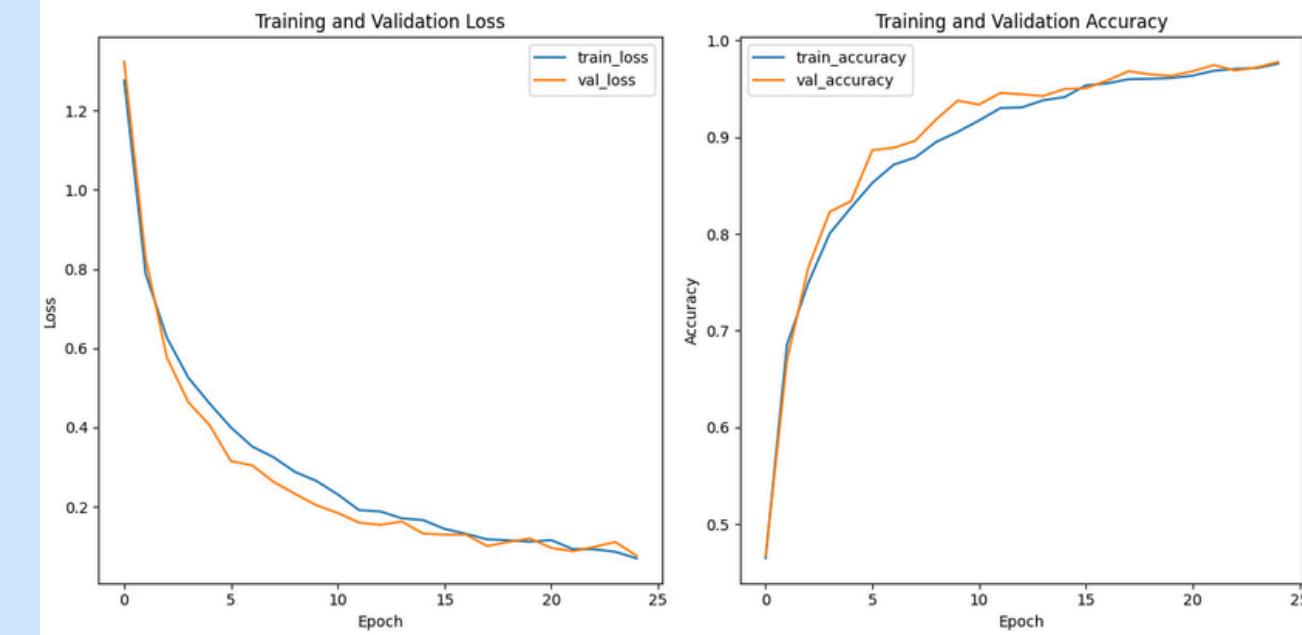
Train Accuracy:89%
Test Accuracy:87%

MERG_DataSet



Train Accuracy:93%
Test Accuracy:91%

DataSet.2



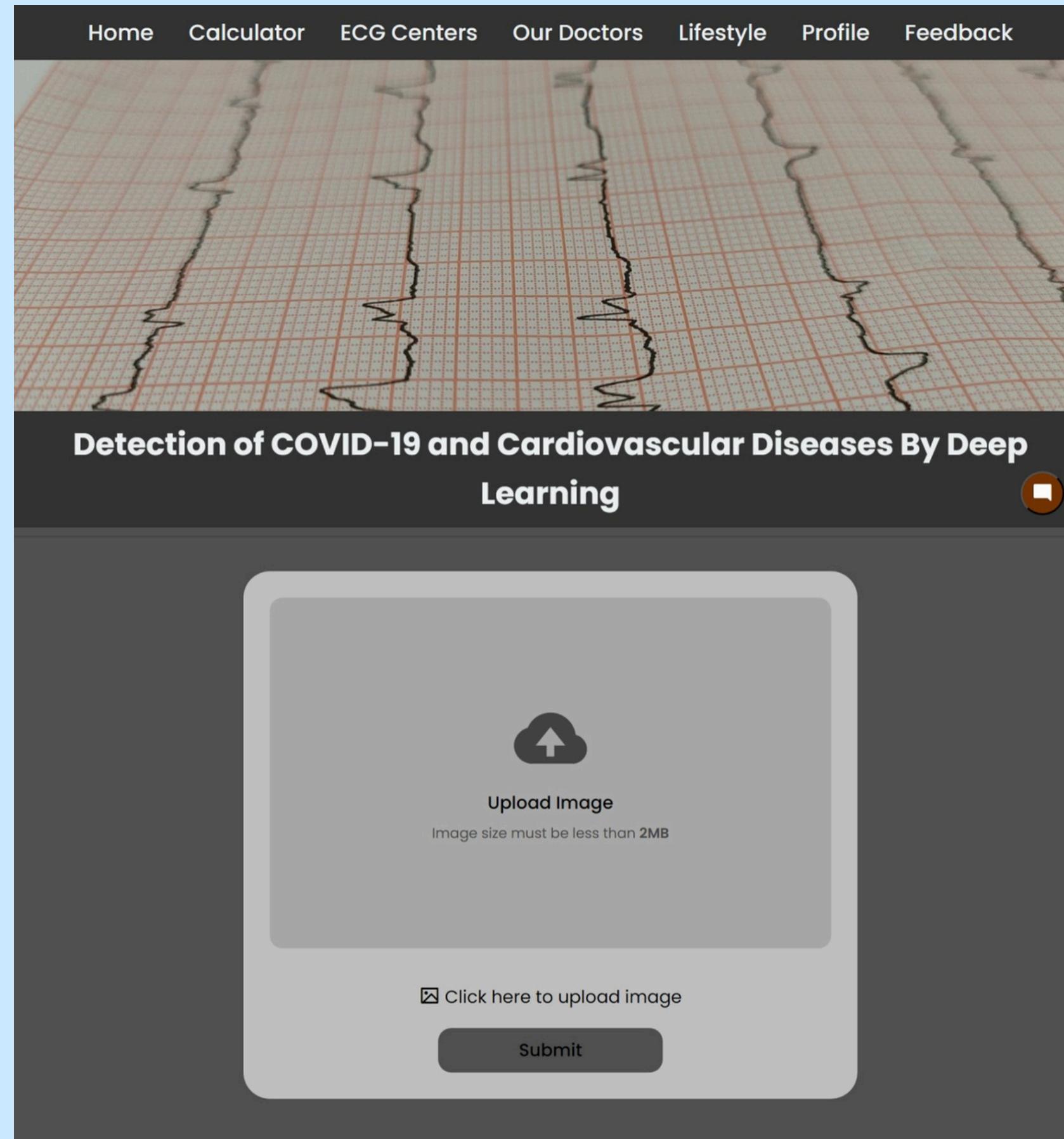
Train Accuracy:97.5%
Test Accuracy:97.2%

Sign Up or Sign In



Detection of COVID-19 and Cardiovascular Diseases By
Deep Learning

Upload ECG-Image



Chatbot for any Patient's Question

Home Calculator ECG Centers Our Doctors Chatbot

Hi there 🙌
How can I help you today?

Detection of COVID-19 and Cardiovascular Disease

Learning

Enter a message...

X

Risk Calculator

HEART RISK CALCULATOR INFORMATION



Estimate Your Heart Risks from Heart Risk Calculator.

Based on the knowledge and experience we are gain from internet we implement an open source heart risk calculator, this health assessment can help you:

HEART RISK CALCULATOR DEMOGRAPHICS



Learn your heart risk category, and what is normal
Evaluate your risk for that heart attack, stroke disease and more
Learn your Body Mass Index (BMI) number, and BMI category

GET STARTED

Age (years)

160

Systolic Blood Pressure

mmHg/dL): 40

Physical activity (hours per week)

hours per week): 6

Weight (kg)

kg

Are you a smoker?

history of heart disease?

Your Heart Risk: 5%

Your BMI: 24.22

Your BMI Category: Normal weight

Calculate Risk

ECG-Image Centers

 [Alfa Labs](#)
sohag Governorate

★★★★★

[Read More](#) [Location](#)

 [Cardio Scan](#)
Al-Sharqia Governorate

★★★★★

[Read More](#) [Location](#)

 [Taiba Scan & Lab Center](#)
BeniSuef Governorate

★★★★★

[Read More](#) [Location](#)

 [Cairo Scan](#)
Giza Governorate

 [Dar Al Fouad Hospital](#)
Cairo Governorate

 [Techno Scan](#)
Dakahlia Governorate

Read More Location

Read More Location

Our Doctors



Dr. Mohamed Fouad

Expert Doctor



Dr. Amr Imam

Expert Doctor



Dr. Mohammed Suleiman

Expert Doctor



Dr. Ahmed Helmy

Expert Doctor



Dr. Yasser Al-Nahhas

Expert Doctor



Dr. Amany-jamal-Al-Deen

Expert Doctor



Lifestyle Page

contains recommended Healthy Food and Sports for Heart Patients and Covid-19 Patients

Healthy Food
Some healthy recipes for heart disease and Covid19



Whole Grains
Opt for whole grains like whole wheat, brown rice, oats, rye, and quinoa. These grains include all three nutrient-rich parts: germ, endosperm, and bran.



Leafy Green Vegetables
Spinach, kale, and collard greens are rich in vitamins, minerals, and antioxidants. They contain vitamin K, which helps protect arteries and promote proper blood clotting.



Fatty Fish and Fish Oil
Salmon, tuna, and trout are rich in omega-3 fatty acids, which have anti-inflammatory properties and support heart function.



Green Tea
High in polyphenols and catechins, green tea has been linked to improved heart health.



Avocados
These creamy fruits are a great source of monounsaturated fats and potassium. They can help regulate blood pressure and improve heart health.



Walnuts
These nuts provide heart-protective benefits due to their omega-3 fatty acids, antioxidants, and fiber content.

Sports
Sports play a vital role in promoting physical and mental well-being



Swimming
Swimming is a remarkable activity that offers numerous benefits for both physical and mental well-being.



Running
Improved sleep quality and duration increased weight loss and metabolism Lowered blood pressure and cholesterol levels



Cycling
Cycling strengthens your quads, glutes, hamstrings, and calves without stressing your joints!.



Yoga
Yoga enhances flexibility by incorporating various postures and stretches and may reduce inflammation and contribute to overall cardiovascular well-being



Tennis
A study published in the British Journal of Sports Medicine found that people who play racquet sports, including tennis, have a marked reduction in all-cause mortality and a significant decrease in cardiovascular disease mortality.



Golf
Golfers have been found to have improvements in risk factors for cardiovascular diseases, such as lipid and insulin-glucose levels, body composition, and physical inactivity.

Patient Profile

contains all data that the patient entered on the website

Patient Profile

Normal Person

Name	Jonathan Nemr
Age	40
Email	jonathanehab934@gmail.com
Phone Number	01275664477
Weight (kg)	70.00
Height (cm)	170.00
Total Cholesterol (mg/dL)	160
HDL Cholesterol (mg/dL)	40
Systolic Blood Pressure (mmHg)	120
Physical activity (hours per week)	0.00
Alcohol Consumption (drinks per week)	0
Are you a smoker?	No
Do you have diabetes?	No
Family history of heart disease?	No
ECG Image	
Doctor's diagnosis of your status:	From Dr John Your Status is Excellent please go to hospital ?? From Dr Hana Your Status is Excellent you should take medicine now

Comment and Evaluation of Patients for Website

Patient Feedback

Comment: Lorem ipsum dolor sit amet, consectetur adipiscing elit.

By: John Doe (john@example.com)

Rating: ★★★★☆

Comment: Nulla quis lorem ut libero malesuada feugiat.

By: Jane Doe (jane@example.com)

Rating: ★★★☆☆

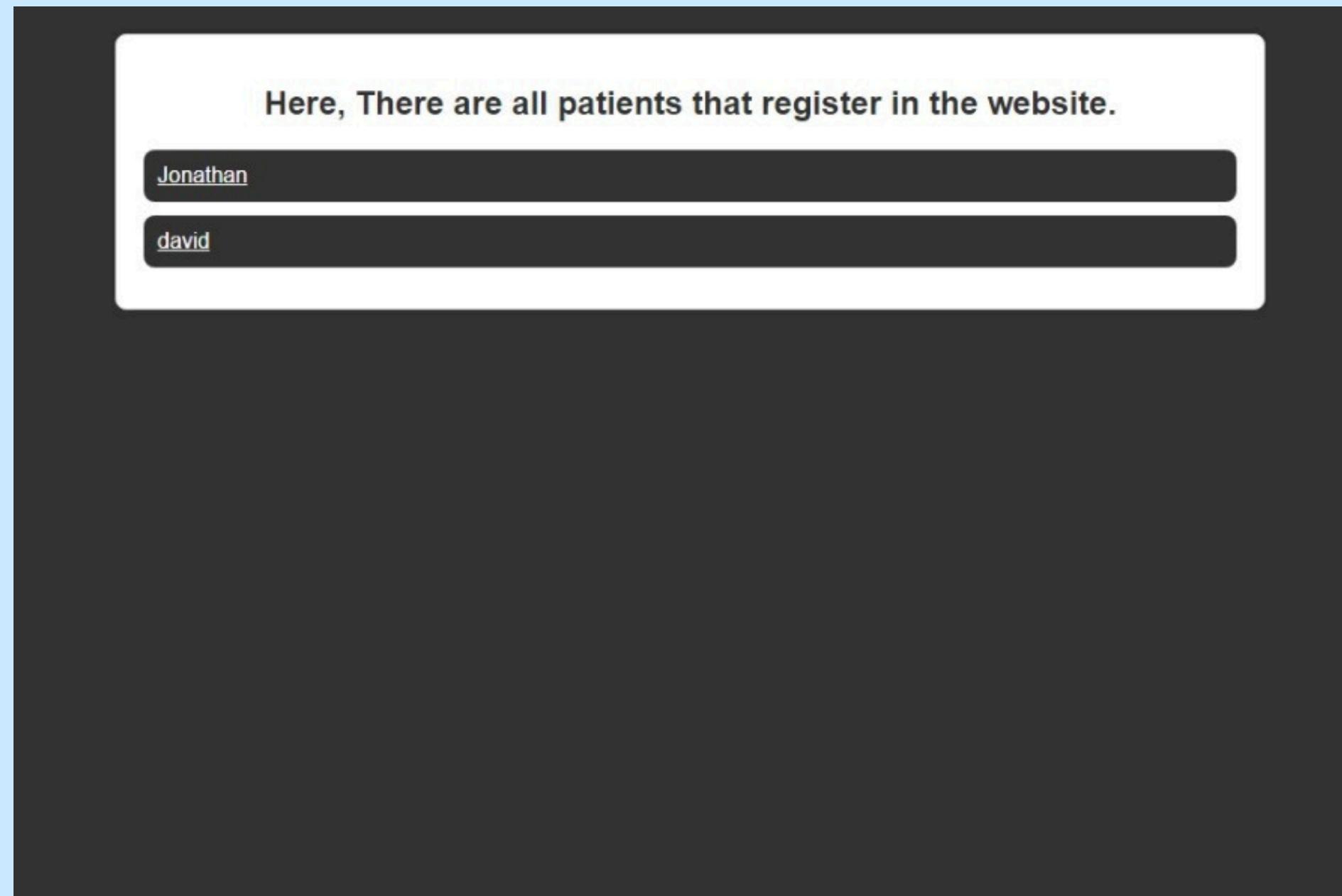
Add your comment...

Comment:

Rating: ★★★★☆ ▾

Submit

Doctor's Diagnosis per Patient depending on his/her Status



Hello Doctor

Please give your opinion and diagnosis of this patient's status after reading the patient's information.

Patient Status:

Doctor's Comment:

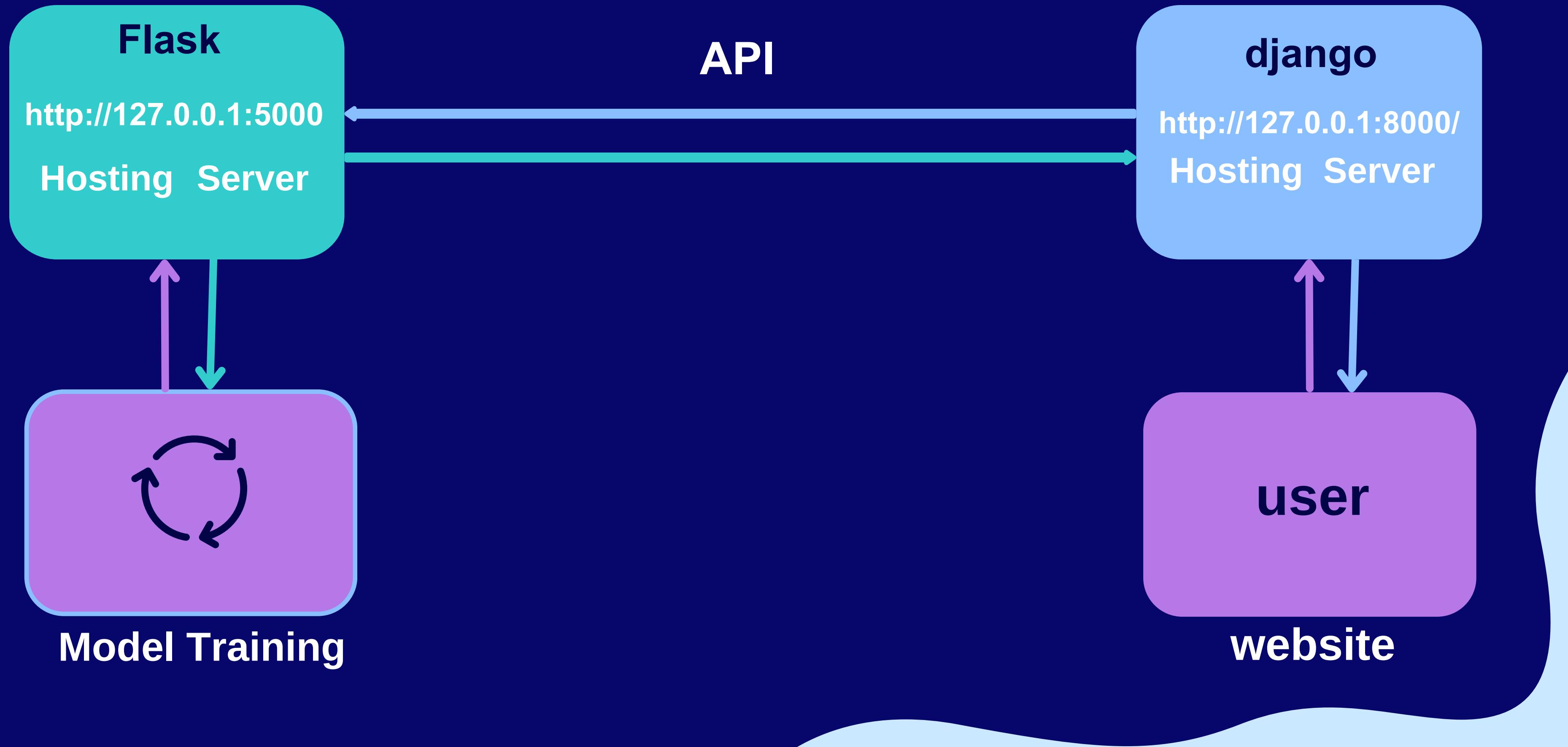
Normal Person

Age	40
Weight (kg)	70.00
Height (cm)	170.00
Total Cholesterol (mg/dL)	160
HDL Cholesterol (mg/dL)	40
Systolic Blood Pressure (mmHg)	120
Physical activity (hours per week)	0.00
Alcohol Consumption (drinks per week)	0
Are you a smoker?	No
Do you have diabetes?	No
Family history of heart disease?	No
ECG Image	

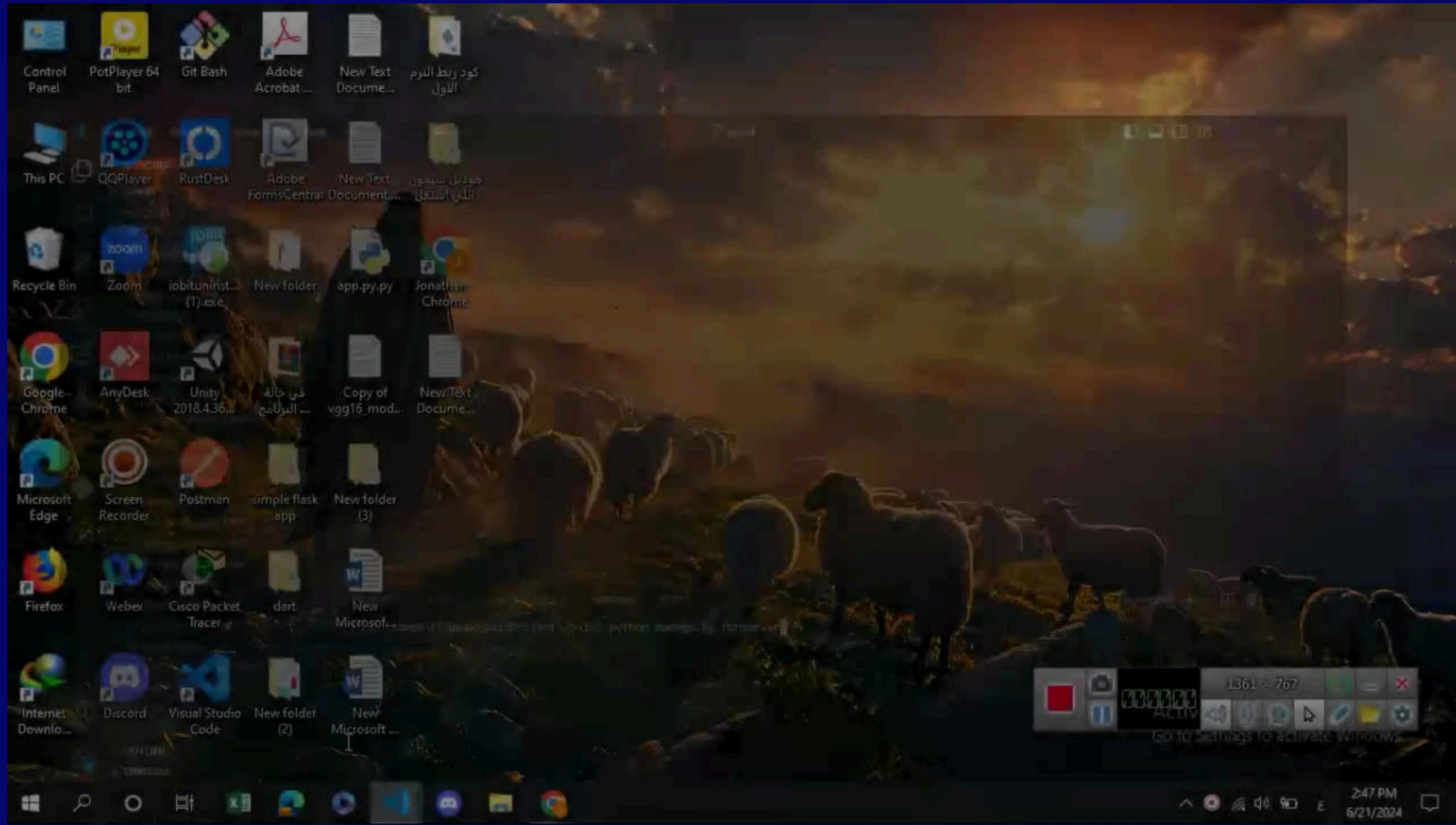
Link model and make Api for website using flask

- 1** Create file “app.py” includes the deep learning model To be uploaded to the Flask server
- 2** When user upload image in website that sent a POST request to the URL "http://127.0.0.1:5000/predict".
- 3** the Api will get photo and go to server of flask to get result by post request from server Django
- 4** it retrieves the response text from the server When the request is complete to display the predicted category at same page and save in user profile.
- 5** The response will appear to the user and will be recorded on the profile page so that the user and the doctor can view it

★ Architecture Overview



Demonstrate implementation through video

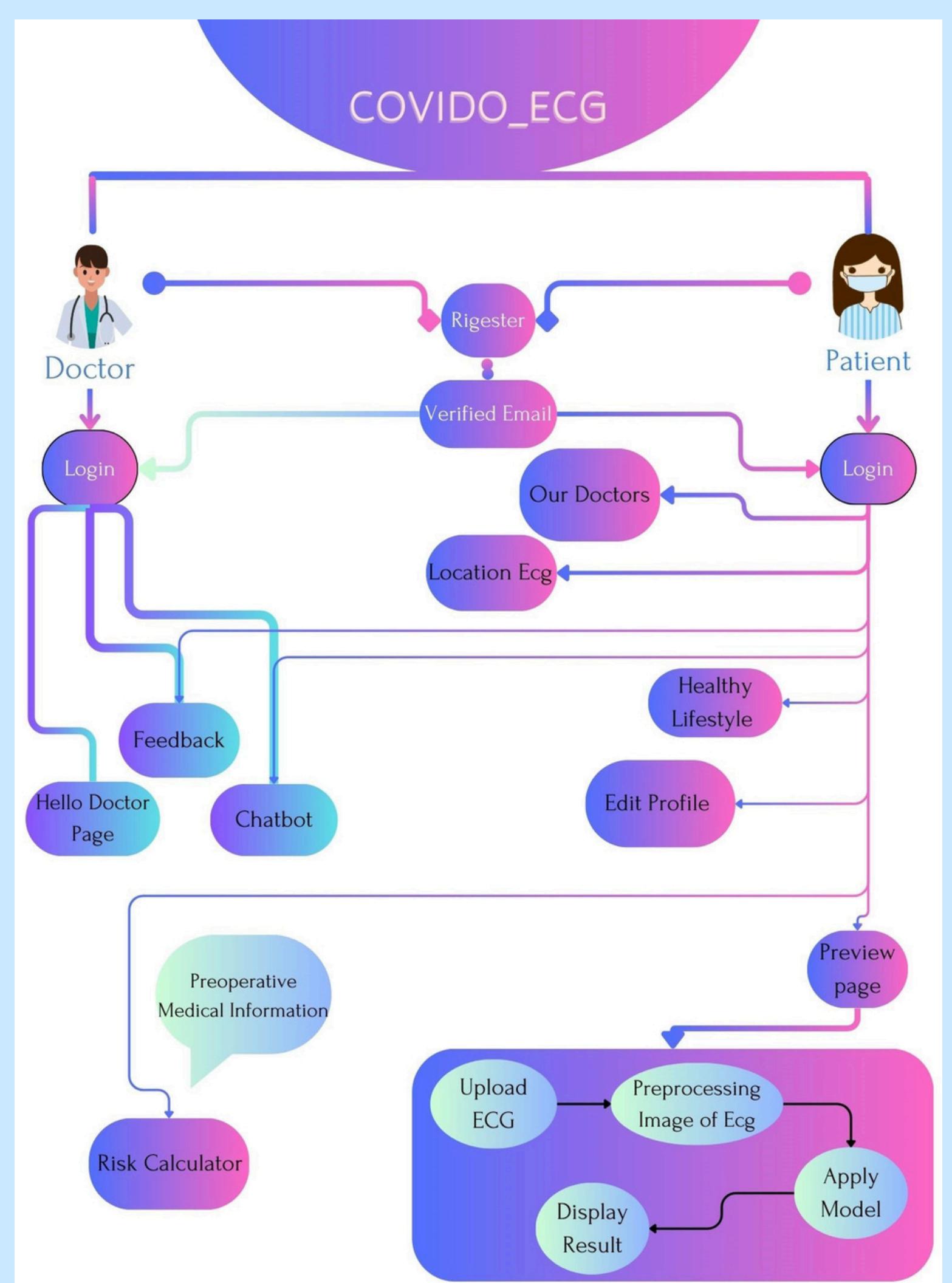


09

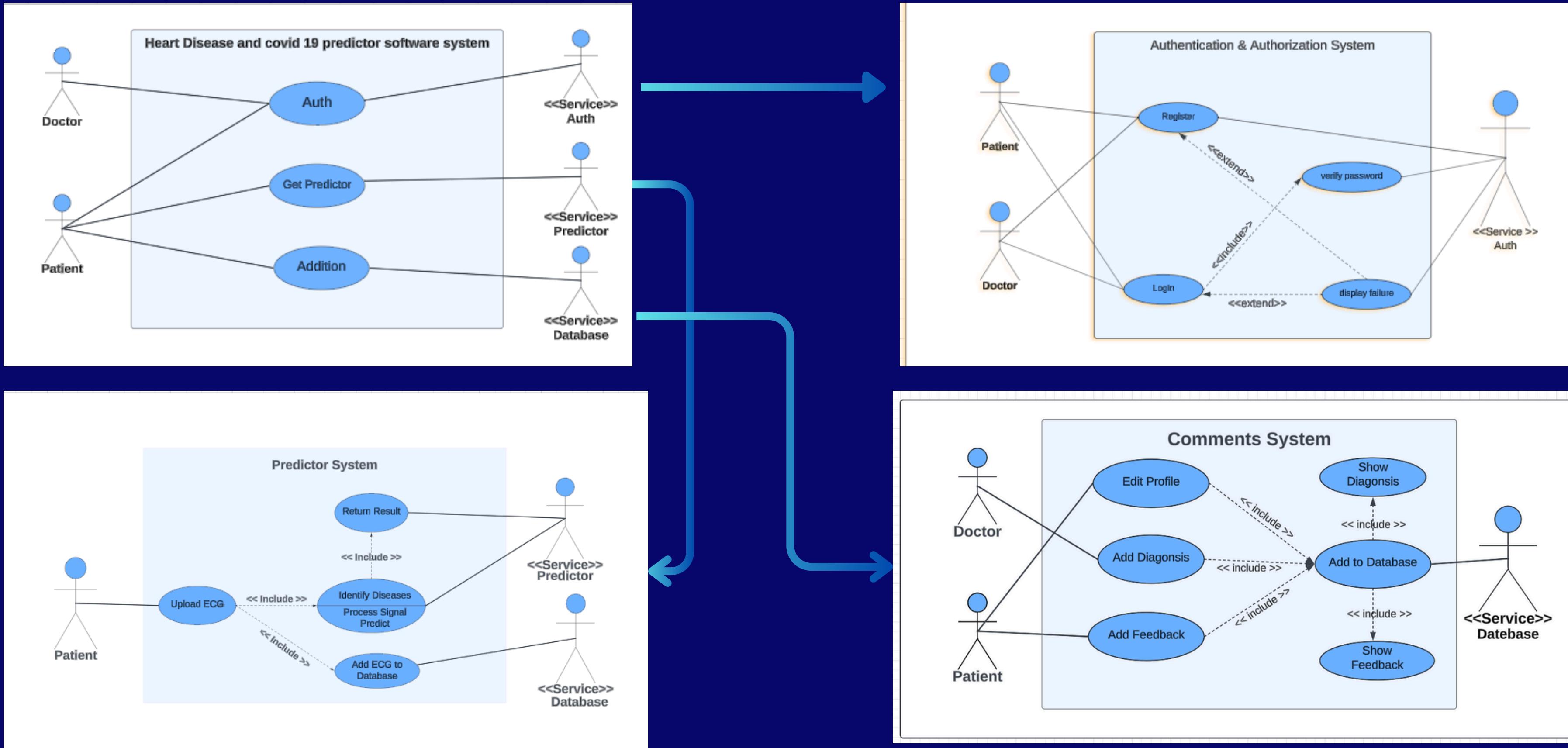
Methodology



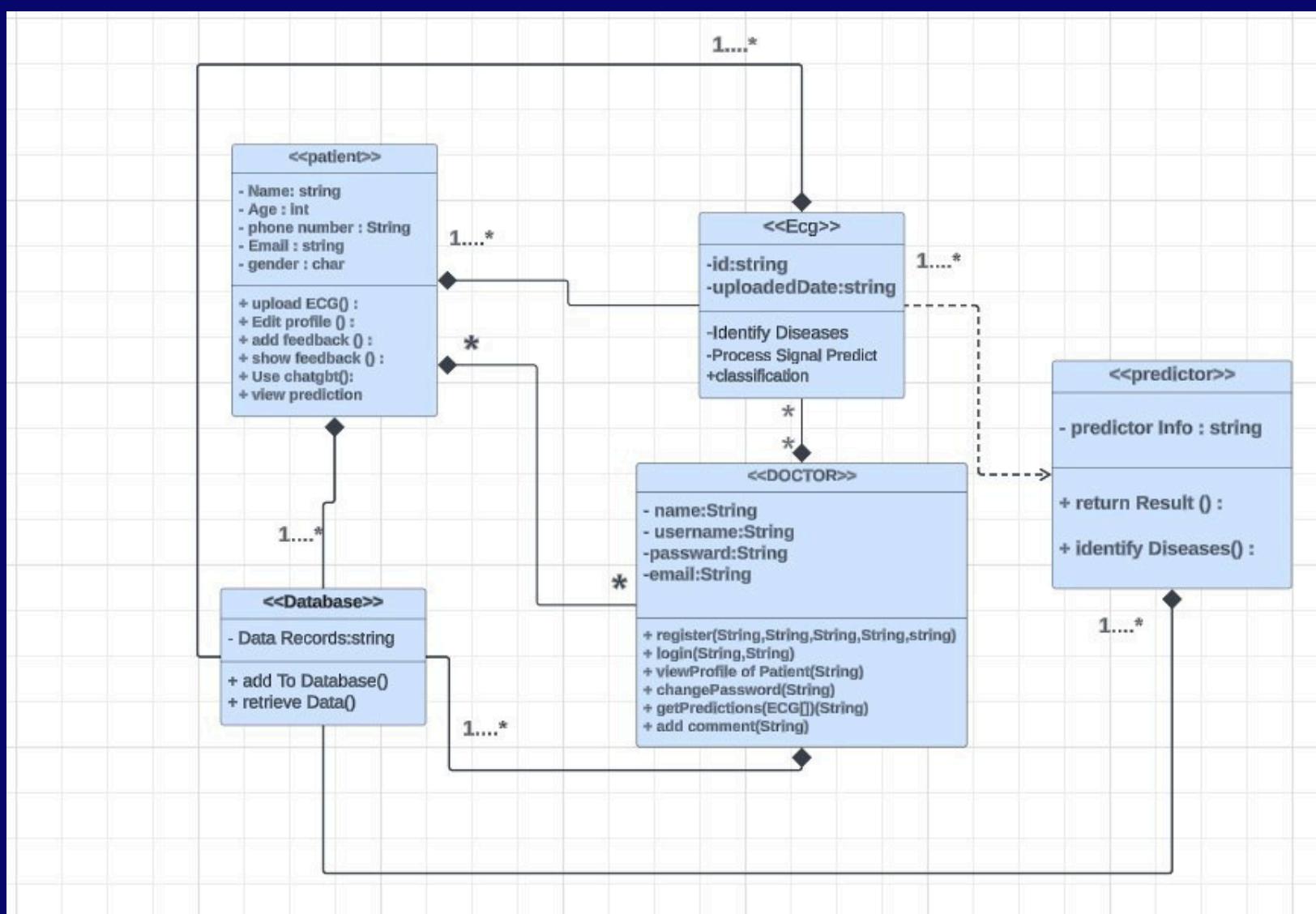
Structure of System



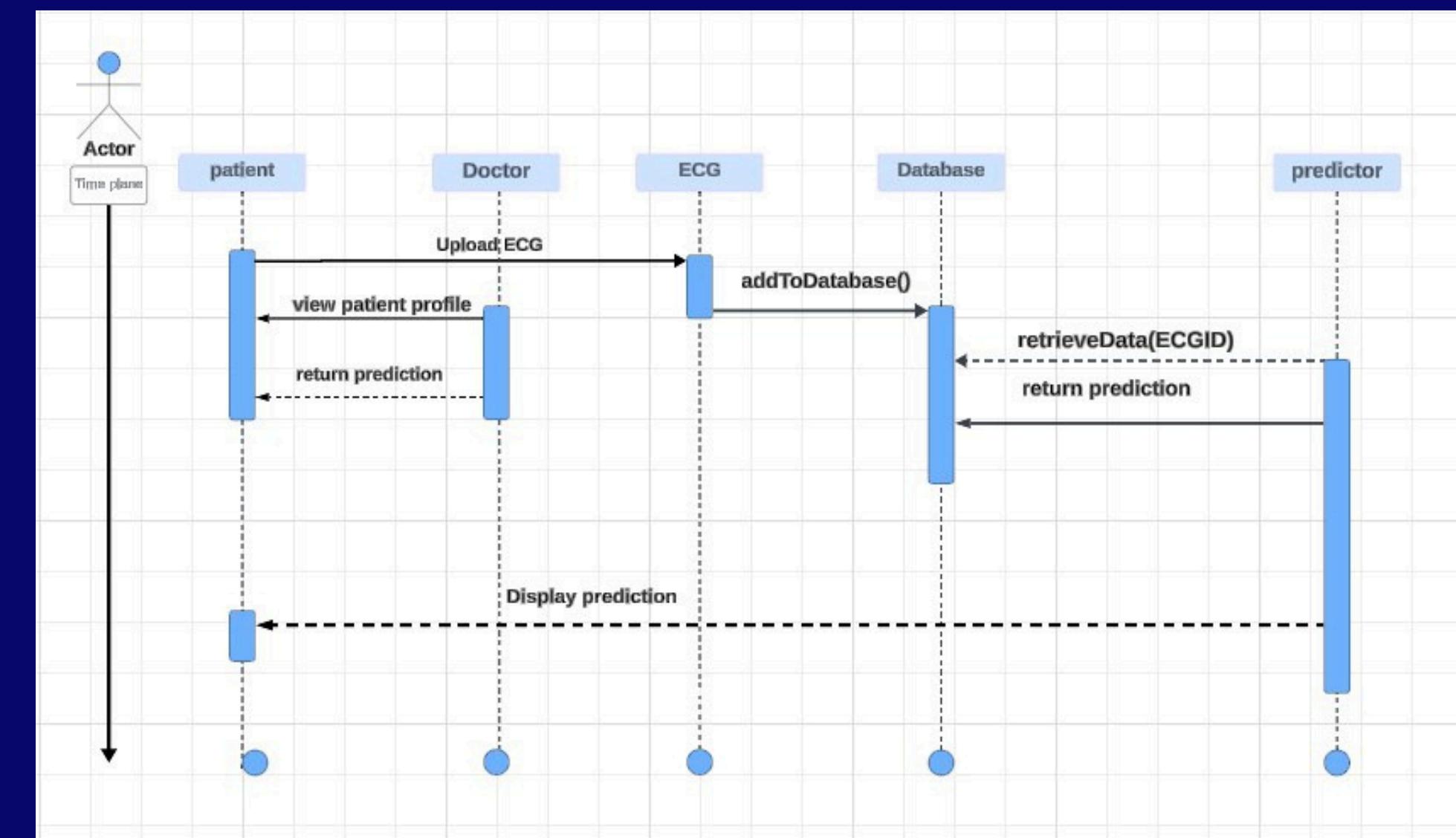
Use Case Scenarios



class diagram



sequence diagram



10

Technologies



BACK END

django



 **python**™

AI



FRONT



11

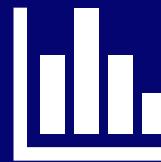
TIME PLAN



Time plan



Research and understand the idea of the project



Data visualization



- Implementation and build the model.
- Link model and make Api for website.



Obtain the final version of the project and to amend any proposals from the doctor and teacher assistant.



Understanding the dataset



- Preprocessing for data and augmentation
- Create a web site and **create database in MySQL**



- Improve accuracy
- add new features to website

THANK YOU
VERY MUCH!

THANKS

